Paving and Municipal Engineering

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LIGHT TRAFFIC WHEELS.

THE cost of wheel traffic over roads and streets is a matter of very serious importance. Its importance arises not so much from the undoubted greatness of its amount as from the great amount even by which it might be so easily reduced.

The cost of traffic is a tax upon everything concerned, produced, bought, sold, begged, borrowed or stolen. No one can escape payment of this tax. About everything is hauled, as about everything connected with its production, including its transportation, has been hauled before it.

The total cost of traffic is made up of:

First. Cost of horses—power.

Second. Cost of roads and streets } Cost to lessen power and
Third. Cost of vehicles } total cost.

In fact, the whole is cost of power, which includes the cost of rendering the power available and of lessening the amount required for a given quantity hauled.

Taking up the subject at "roads," where most writers begin and leave off, we have to begin on the well-established fact that roads and streets are very expensive when kept in the proper surface condition. But in reality they "cost" more still when not kept in such condition. In view of these facts, it is extremely important to know also that they may be kept in such satisfactory condition at greatly less "cost" (cost to traffic, volume for volume), under light traffic wheels than under present heavy traffic wheel conditions.

Besides this pavement and wheel cost of traffic, in which must be included the cost not saved by them, there is generally a very arge cost due to grades. Before we can properly compare the

traffic cost of the various pavements on road surfacings, or get a correct idea of the immense advantage of lighter traffic wheels, we must carefully exclude cost due to grade.

Surfaces and wheels, and combinations of the two, must be compared with reference to the saving effected by them, and not by grading or avoidance of grade, by which alone grade cost can be lessened.

On a grade there is the same surface and wheel traffic cost as upon a level, and in addition, a grade traffic cost, consisting of the cost of the vertical component of the pull up grade, cost of extra wear on horseshoes, vehicle and harness, and any extra cost of the surface due to the requirement for better foothold, as well as the greater wear from horseshoes.

With these preliminary remarks we may proceed to consider the subject from and in relation to the usual standpoint.

GOOD ROADS AND STREETS; HOW TO GET THE BEST; HOW TO KEEP THEM AT THEIR BEST.

The best are those which both can be and are kept in the best condition for a given total cost per ton to and from traffic. For purposes of communication and transportation we must have motive power and right of way. We have horses, and roads and streets. The cost of these alone, without traffic facilities, is the original and greatest cost of traffic.

We should distinguish between traffic-first-cost and traffic-maintenance-cost. Any cost of right of way; acquiring, donating, or improving permanently by grading, straightening to avoid distance, curving to avoid grade, etc., is first cost. The never ending expense for surfaces and horse power is the maintenance cost. The whole expense of traffic, including the cost of the necessary way, is for horses and their use, and traffic facilitation operates to reduce that expense by reducing the number of horses required.

We may facilitate traffic by improving the way in respect to length and grade elevation. This may, and generally does, increase the traffic-first-cost, but reduces by a larger amount the traffic-maintenance-cost. All extra length of way between two points, when not itself the result of avoidance of grade, may be avoided without extra cost. Grades may be avoided by change of way from "over"

to "around" elevations, or may be reduced by grading, until the interest on the cost of grading per foot of elevation say, equals the saving due to the same. It would be easy enough to find the point where grading costs as much as it comes to, if traffic tonnage were not subject to change, and along with it, the grading-interest-charge which the traffic can profitably bear. We must consider the probabilities, taking care to err on the side of extra grading rather than extra grade. Every consideration of economy, however, points to the most painstaking avoidance of grade wherever a way around can be found.

Having carefully corrected the direction of our surface, we must proceed to correct the surface itself and to use such vehicles (wheels) as will best aid in the correction, and most facilitate traffic generally.

Assuming that we have facilitated traffic as much as we can by means which add to its first cost, we have the maintenance cost or operating expenses to consider. This we may divide into "surface cost" and "grade cost."

The surface cost is common to all roads and use of roads.

Grade cost is additional cost due to grade. We may have no grade on our road, in which case we have to deal with horizontal pull only. If grade is added, we have the same horizontal (component of) pull due to the surface, plus an added vertical component due to the grade.

It is especially important that all traffic cost added by grade should be eliminated from all comparisons of surfaces and their use. It is obviously unfair to the better surface and mode of using that surface to include it, and not unfair to the worse surface and use to exclude the cost added by grade, as neither affecting nor affected by the surface cost proper.

GRADE TRAFFIC COST.

The traffic maintenance cost due to grade is the cost of any pull which does not take effect in lessening the distance in feet or miles to be traversed. Grade forces the horse to go and pull out of the horizontal direction, which is the best. When the load is on an up-grade, gravity pulls backward; when on the down-grade, gravity pulls forward, but when resting or moving on a perfect level gravity has absolutely no effect on the rolling of the wheels.

This brings us to the cost of surfaces and their use. Having made our roads as perfect as we please in respect to grade and length, we should still have left a very serious traffic cost.

SURFACE TRAFFIC COST.

The traffic maintenance cost due to surfaces and wheels is the total cost of the wear produced by and incidental to the rolling of wheels over those surfaces. A small part of this wear cost is due to hub friction, but hub friction wear is independent of tire and surface wear. If surfaces were made so perfect as to offer no resistance whatever to the rolling of wheels, hub friction and grade cost would remain unaffected, hence, both must be excluded in discussions of surfaces.

Tire and surface friction, cost of horses, vehicles and surfaces is practically the only traffic cost which the character or style of vehicle or pavement affects. It is true that grade so increases pull that greater foot-hold roughness is required, and greater foot-wear resisting power, and that this causes greater shoe wear and tire and surface friction wear, but this cost is to be included in grade cost.

We thus limit the further discussion, not only to wear cost, but to tire and surface wear cost simply.

TIRE AND SURFACE WEAR COST OF TRAFFIC.

Tire and surface, or rolling friction wear, cost includes all cost not traceable as hub friction or grade cost. It is made up of the cost of surfaces placed, worn, and repaired or replaced; cost of vehicles bought, worn, and repaired or replaced; and the cost of horses bought, worn, shod, fed, harnessed, driven and replaced, in so far as such cost is not due to hub friction or grade. For the purposes of this discussion, surfaces and vehicles are considered as costing the whole amount, since, for purposes of comparison, we may add to their own proper cost the cost not saved by them. Of course, the "cost not saved" is cost which would be saved by theoretically perfect surfaces and vehicles. We may get a better idea of this cost by considering it as the combined cost of wearing out surfaces with wheels moved by means of horses, harness, drivers, etc., and cost of maintaining those surfaces, including all cost of making them easier to maintain, etc. It is comparatively easy

to get at the maintenance cost by taking the cost on a level, but since some part of the cost of vehicles and a much larger proportion of the cost of horses is due to grade, we can not easily ascertain the actual cost due to wearing the level portions, or the equivalent cost of the horizontal component of the pull on the grade. But this fact does not prevent us from getting at this cost in some other way.

We may safely say not only that the cost of repairing the damage is greater as the wear damage is greater, but that the cost of doing the damage is greater as well. We know the fact that great wear is produced on a level, hence by the surface pull on a grade. Besides, if "heavy traffic" did not mean great wear of and to (hence by and from) surfaces, or the "necessity" for still greater counteracting, wear resisting quality of surface, we should hear and see very little about "heavy traffic." As it is, we have the iterated and reiterated statement that "nothing but granite blocks can withstand the wear of heavy traffic." We are assured that granite block pavement does stand the wear and tear beautifully, but comparatively little is said as to how "heavy traffic" and the involved "light traffic" stands the wear and tear of the granite block!

We may approximate the cost of producing tire and surface wear by estimating the cost of any equivalent wear produced in some other way; say with the tools and the application of horse power best suited to produce the same wear as an end, then adding liberally for the greater cost of doing the work as it is done, viz: with tools (wheels) especially designed to prevent wear, and consequent pull, or pull and consequent wear.

We have the wear and the pull—gravity brings the one about and that one superinduces the other. The question is, how can we bring about the greatest reduction in either and consequently both.

Manifestly we can not reduce the wear per ton by reducing the volume of traffic, and the weight of loads should be increased, if anything, since drivers cost more as loads are lighter. How far this advantage of heavy loads is offset by the present "remedy" for the increased wear—by the extra cost of foundations or cost of extra thickness of metal "required" and the increased tire-and-surface cost of the "required" granite block as compared with asphalt for example—I shall show later on.

We are to discuss here the best means of reducing the wear (or

the pull) per ton hauled, and the effect of the greatest reduction of wear upon the cost of traffic and upon the comparative economy of various surfaces.

The use of asphalt for surfaces has already reduced the combined wear of vehicle and surface in terms of the pull caused, to say 15 pounds pull per ton on the horse and any resultant effect. The gross saving due to asphalt is greater than that due to any other pavement or surface. Its use means the least combined wear (independent of the cost of replacing) and cost of wearing known to us commercially.

Taking it for granted that in general the cost of wearing out a pavement or other surface is greater than the cost of replacing the same, and that this is true of asphalt; and admitting for the present that asphalt pavement is costly, as claimed, we see that a large part of the pull of "15 pounds per ton" must take effect in, or be absorbed by *wear*, thus leaving a lessened share of pull to represent the cost of wearing the pavement with horses and vehicles. The wear-and-cost-of-wearing is given at 33 to 66 pounds per ton of load on granite block—33 pounds at a speed of a walk; 66 pounds at a trot. Assuming that these figures—15 and 33 to 66—are substantially correct for springless vehicles, and that springs are chargeable to the granite, we find that granite costs from 18 to 51 pounds more pull per ton hauled than does asphalt. This is 18 to 51 pounds more per ton pulling back on the horse and also 18 to 51 pounds more per ton taking effect in wear on pavement and vehicle. We can not say how much pull costs per pound on either surface, but we can say with perfect safety that a pound of pull on granite costs more than a pound of pull on asphalt.

The pull per ton at a trot on granite of 66 pounds as against 15 pounds on asphalt, must have a great effect upon the traffic rate of speed expressed in ton-miles per hour or foot-pounds per minute. Let this effect be to slow up traffic enough to reduce the average highest speed pull to 57 pounds. This would make the average excess pull on granite 30 pounds per ton. Now, it is clear that we may make the pull per ton on asphalt greater than it is by this 30 pounds, that is make the pull 45 pounds. We should simply have to make wheels enough more destructive. To be more destructive, they must be narrower, or smaller, or both. But if we can make

the pull greater by reducing size and width of wheels, we should be able to make it less by increasing size and width, unless these are already just what they should be.

Assuming that the average size of wheels is not far wrong, let us study the effect of increased width. Tire and surface wear, or rolling friction, depends upon the intensity of the pressure per ton of load, and the failure of the surface and wheel to stand that pressure without appreciable damage. Upon asphalt the intensity of the pressure depends upon absence of wheel width per ton. That is, upon a sufficiently flat asphalt surface, the broader the wheel the less the intensity of pressure, and down to a certain, safe intensity, the less the wear to surface, vehicle and horse.

Now, there is scarcely a writer upon this subject who does not refer to "traffic which is too heavy for asphalt." This means simply that the intensity of the pressure between wheels and surface is too great; hence that wheels are too narrow per ton of load. It means that we use "heavy traffic" wheels on asphalt whereas we might use light traffic wheels. This applies to earth, gravel, brick and macadam surfaces, but not to granite or other rough stone block pavements. The roughness of ordinary granite block pavement is such that no reasonable wheel width would do away with much of the pull. Whatever the width of wheels per ton that might be in use on granite, springs would be necessary, as they would not be on any but stone block surfaces.

Comparing asphalt and granite block pavements as the cheapest and best of their respective classes, we find as follows: The best asphalt costs in Chattanooga, St. Louis and other places $2.75 per square yard. Guaranteed maintenance costs, for first five years, ten cents; second, thirty-five cents; and for third five years (say fifty cents). The foundation costs about $1.00. Maintenance charges might be reduced from thirty-five cents for second five years to ten or fifteen cents, provided the best general average wheel width per ton were used. This is equivalent to saying that while thirty-five cents is the least safe charge with present wheel widths in use, wheels might be so widened as to make ten cents, or, at most, fifteen cents, safely cover the risk. Such a reduction of wear on the surface would probably justify a reduction of the thickness of foundation by about twenty or twenty-five per cent. These re-

ductions would make the cost of asphalt in fifteen years, say $3.00. Another fifteen-year period would cost $1.50 for relaying and fifty cents for guaranty; total for thirty years, $5.00. It is safe to assume that the cost of wearing out the asphalt—cost of horses, vehicles, etc., wearing it—will be as great per yard as the cost of placing, replacing and repairing the pavement per yard, or about fifteen cents, which is one cent per pound of pull per ton.

We are, however, not so much concerned about the absolute tire and surface cost of asphalt and granite as about their difference in cost. Taking cost of granite block at $4.35 (average of 50,000 yards laid in Memphis) and allowing 30 years as the life of this pavement and without charging in any cost of repairs, we find the excess cost of granite over asphalt to be in the 30 years about $5.00 per yard. This is the difference between the two costs at compound interest at six per cent. for 30 years, or the result at the end of the 30 years of adding six per cent. interest to the difference in cost up to the beginning of each successive year. In 60 years this excess becomes about $33.00 per yard.

Treating the difference in wearing cost in the same way, we have, as the result of compounding interest at six per cent. on thirty cents per yard per year to the end of 30 years, $24.00 per yard. In 60 years this would become $163. Adding the excess cost of the granite itself to the excess cost of using it, we have $29.00 per yard in 30 years or $196 per yard in 60 years.

Of course, no one would put the difference in cost between two pavements out at interest, but this simply means that we can get a larger return for the money by putting it into more of the less costly pavement. Hence, the compound interest which we could get on it if we should keep this difference at interest, and which we as obviously lose by not keeping it so, is less than the actual loss on account of the larger area left unpaved. The same reasoning applies to the saving in cost of using the pavement. We lose the excess cost of using, plus the compound interest, or something which we prefer to such interest.

WHEELS.

It is just as important that we should have the best traffic wheels as that we should have the best traffic pavement or road surface. Indeed, it is not possible to have the best of one without the best of

the other. The "best" means that which will most cheapen traffic, and is to be determined for each case separately.

The cost of paving or surfacing should affect the size and width of wheels per ton of load, since these dimensions affect the cost of paving as well as the cost of using the wheels themselves. We should use the best combination of widest and largest wheels where the cost of paving or surfacing is prohibitive, as is the case for log hauling in swamps. In this case, width added to wheels is vastly cheaper than any surfacing which would give the same reduction of pull for wheels of ordinary width. Approximately the same thing is true as to earth roads in the earlier stages of traffic over them. As the tonnage becomes greater and the value of the traffic per mile of road, or yard of street surface, becomes great enough to bear a surfacing or paving tax, the wheel width per ton may be reduced economically, provided the metaling or foundation is made correspondingly thicker as the number of tons per load is increased.

When wheels were introduced, the intensity of the pressure of load upon road surface was greatly increased. We still further increase this intensity whenever we make the road surface harder. So far as the surface contact is concerned, the increase is more than offset by the fact that the pressure is, so to speak, rolled over the surface instead of dragged as in the case of a sled, and that the resistance of the surface to crushing increases more rapidly than the crushing intensity of the pressure.

But the full pressure is transmitted to the earth in any case, and the underlying metal or pavement foundation must be thick enough to sufficiently redistribute the pressure which the hardness of surface or narrowness of wheel has concentrated. Hence the narrower the wheel (per ton of load) or the more unyielding the surface, the thicker must be the distributing foundation material. This rule can not apply to ordinary stone or "granite" block pavements, since the area of supporting base is practically constant, whatever the hardness, and for all widths of wheel. In this case the proper thickness of foundation depends upon the area of base of the smaller blocks, the roughness of surface, and the greatest combined speed of springless vehicles and total load per wheel of a given size (diameter).

Thus we find that in order to reduce the cost of granite block

foundations we must either use larger blocks without making the pavement any rougher, or cut the blocks smoother, or use springs on heavily loaded vehicles, or reduce combined speed and load, any one of which would cost more than it would come to.

In the case of what we may call the more scientific surfaces, such as asphalt, brick, macadam, gravel and earth, it is manifest that we have only to arrive at the best combination of broader wheels (per ton of load) and flatter crowning of surface; in order to reduce both thickness (and cost) of foundation material, and cost of surface, vehicles and horses. It is to be noted that for a given surface, the wheel width is to be increased somewhat less per ton as the load increases, and that for an improved surface the width per load of given number of tons may be less still, but for a given foundation or thickness of foundation the width per ton must be increased for each additional ton. Having reached the limit of width best suited to each surface, we should have to establish a compromise width for use on two or more surfaces. While it might be cheaper in some, on all separate cases to thicken foundations rather than widen wheels after the surface requirement had been fully met, still where wheels are to be used partly on inferior surfaces, they should be given the width (per ton of load) requisite for use on such surfaces, and the foundations of superior surfaces should then be proportioned accordingly. In this way the standardization of wheel width (per ton of load) for all surfaces could be so simplified as to make it possible to use a constant width per ton to advantage.

As it is, we have practically one width *per horse* for all surfaces except where the strength required for wheels used on granite block demands a greater width. So that we find the wheels in use to be such as are better suited to the hardest and roughest pavements with thickest foundations; or rather, not suited to any surface, since they make heavy loads so destructive to all other surfaces that granite block is "required" to "withstand" them, whereupon wider wheels are necessary to give the requisite strength to withstand the destructiveness of the granite. It would be far better to so widen wheels as to prevent the use of granite block than to use the granite pavement as least affected by wheels, and then have to widen wheels to prevent too great destruction of vehicles by the pavement.

When we come to compare the effect of increased size with that

of greater width of wheels, starting with wheels which can be changed in one direction as much as in the other, we find as follows: If, for a given width, we double the load, we must make the wheel about four times as large, in order that the tire and surface effect shall remain unchanged. The pull per ton would be reduced by one-half. However, it is plain that we can not enlarge wheels as much as we may widen them. Even if we could make the average wheel four times as large as it it is, it is doubtful that the change in diameter would do as much good as the possible and proper change in width. The larger wheel would be better for a given condition of surface—easier on the horse—but it would so rapidly change that condition for the worse that the difference in favor of the wider wheel would show at once; provided, of course, that either wheel would crush or deform the surface. Larger wheels (of constant width) not only cut deeper in the first instance than do wider wheels (of constant size), but they stick closer to the same track the next time and continue to cut it deeper and deeper. It would be very hard to overestimate the difference in cases where the surface material is affected by heat or wet or dry seasons.

Having given a greater destructive effect upon a given surface, we must have also a greater destructive effect upon wheel and vehicle, and both effects must mean a greater pull for the horse.

CONCLUSIONS.

First. The cost of traffic over roads and streets is more important than the cost of the roads and streets themselves. The first cost, and all other cost, of pavements or road surfaces, is simply a part of the cost of maintaining traffic.

Second. In so far as the work of hauling is affected by improved road surfaces, it is simply work of wearing surfaces, wheels, vehicles, harness and horseshoes. The amount of energy expended by the horse in hauling depends upon the wear produced rather than upon weight of load hauled.

Third. The wear produced (per ton of load) depends upon the combined wear-producing and lack of wear-resisting, quality in surfaces and wheels. Hence any one ton may be made to produce as little wear and require as little pull as any other ton ; or, in other

words, the wear and consequent pull on the horse may be made to depend upon weight of load.

Fourth. "Heavy traffic," being due simply to the bad practice of using heavy-traffic wheels, should not be permitted to so completely control the measure of excellence in pavements, as by any possibility to give a high place to any stone block pavement. Granite block makes ordinarily an outrageously heavy-traffic-pavement in the sense that it makes traffic "heavy," just as heavy-traffic-wheels make it "heavy," by increasing greatly the total damage-effect. First we use wheels which no decent surface can stand, then we introduce a pavement which no wheels can stand without the aid of very expensive springs.

Fifth. The best way to make repairs is to make them unnecessary by stopping, in so far as we can, the wear which calls for the repair, thereby stopping also the larger expense of producing the wear.

Finally, the easiest and best way to raise money for roads and streets is to lower the amount of money needed. Doubtless, we should now have four times—probably ten times—as many good roads and streets, if their cost and the cost of wearing them had been made only one-half what it has been. Beyond all question, we can, by giving the proper width to wheels, in connection with the proper crowning of surfaces, make the wear to and from wheels beautifully less, and reduce the pull on the horse accordingly. *J. M. Heiskell.*

J. M. Heiskell, C. E.

STREET-PAVING IN BOSTON.

The annual report of the street department of Boston for the year 1893 has just been published. It comprises nearly 350 pages, and contains much valuable information. The subject of street-paving is given careful treatment, particularly in a statistical way, indicating that exceptional attention is given to this branch of work

BEACON STREET.

Laying Trinidad Lake Asphalt on Cement Concrete Base.

by the Boston street department. For the purpose of comparing the pavements of Boston with those of other large cities, information was gathered as to the kinds of paving in different leading cities. While this can not be accurately classified on the same basis, on account of differences in methods, it indicates the percentage of the different kinds of roadways in some of the leading cities:

DISTRIBUTION OF PAVEMENTS IN PUBLIC HIGHWAYS.

	Washington. Per cent.	St. Louis. Per cent.	Chicago. Per cent.	Buffalo. Per cent.	New York. Per cent.	Philadelphia. Per cent.	Boston. Per cent.
Sheet asphalt	43.90	2.40	1.65	37.97	11.42	9.2	1.26
Coal-tar	15.74	.....	.....	.....	.....	.....	.....
Asphalt block	7.56	.....	0.36	0.08	0.05	2.2	0.18
Block stone	15.82	12.50	2.51	30.25	72.28	24.4	17.35
Wood	.....	2.40	64.38	.....	.....	.....	.....
Cobble	8.98	.....	.....	.....	0.06	31.0	0.79
Vitrified brick	.....	.....	0.11	0.81	.....	5.8	0.08
Rubble	.....	.....	0.11	.....	.....	13.4	.....
*Telford	.....	9.60	.....	0.13	.....	.....	10.12
*Macadam	8.00	73.10	30.86	0.47	16.19	13.4	37.18
*Gravel and dirt	.....	.....	.....	30.26	.....	.....	33.04
Burnt clay	.....	.....	0.02	0.03	.....	.....	.....
Granolithic	.....	.....	.....	.....	.....	0.6	.....
Percentages	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Mileage	165.00	365.83	1,007.05	396.4	455.75	852.14	447.65

*Not usually well separated in the reports of the various cities.

Commenting on these figures, Superintendent of Streets Carter says: "The most striking feature of the above table is the fact that Boston shows such a small percentage of paved streets, and still further, that every other city shows from two to thirty times as much sheet asphalt as Boston. Well may Buffalo boast of being the best-paved city in America, with its one hundred and fifty miles of asphalt and one hundred and twenty miles of block-stone pavement, or two hundred and seventy odd miles of improved pavement out of a total mileage of three hundred and ninety-six miles, as against our eighty miles, mostly of stone pavement, out of a mileage of four hundred and forty-seven miles."

OLD PAVING—TREMONT STREET.

Asphalt pavements in Europe are said to have the following approximate areas and lengths:

	Square Yards.	Miles.
London	370,000	24
Paris	401,617	26
Berlin	1,280,796	83
Other cities	271,000	18
	2,323,413	151

Superintendent Carter further says:

"The city of Buffalo alone has more miles of asphalt than all the cities in Europe, where these pavements have been in use since 1854, while the industry has only been developing in this country for sixteen years. In this short time the United States and Canada are said to have laid in seventy-five cities upwards of 14,000,000 square yards, or 3,000 acres, and an aggregate length of nearly 800 miles.

"Such cities as Scranton, Pa., Wilkesbarre, Erie, St. Joseph, Mo., Louisville, Ky., all contain more asphalt than Boston, while Omaha has five times as much, Washington ten times as much, and Buffalo thirty times as much. This condition of things largely increases the expense of the maintenance of pavements in this city, as the excessive mileage of unpaved streets not only calls for large expenditures for repairs, but the expense of cleaning is increased from $12 per mile to seventy-five dollars ($75), and in some cases to over one hundred dollars ($100) per mile.

"The unevenness and irregularity of slope of some of our older pavements are appalling, due in some cases to a poor foundation or bed, and in some to the free and unrestricted license to private corporations in former years to tear up a pavement without a guarantee of its proper replacement, and to locate drip-boxes, manholes, gate-boxes and covers of various sizes and kinds, all without due attention to the established grade and crown of the streets.

"The inevitable conclusion, both from the comparison of our scant mileage of pavement with other cities, and from the consideration of the inferior, not to say disgraceful, condition of many of our older business streets that have not been repaved for many years, is that a strong effort should be made to provide means for the replacing of these pavements with more perfect and sanitary

DISCHARGE OF OUT-FALL SEWER AT MOON ISLAND.

forms of pavement. Such pavements should be extended as rapidly as possible, until they cover the majority of our streets."

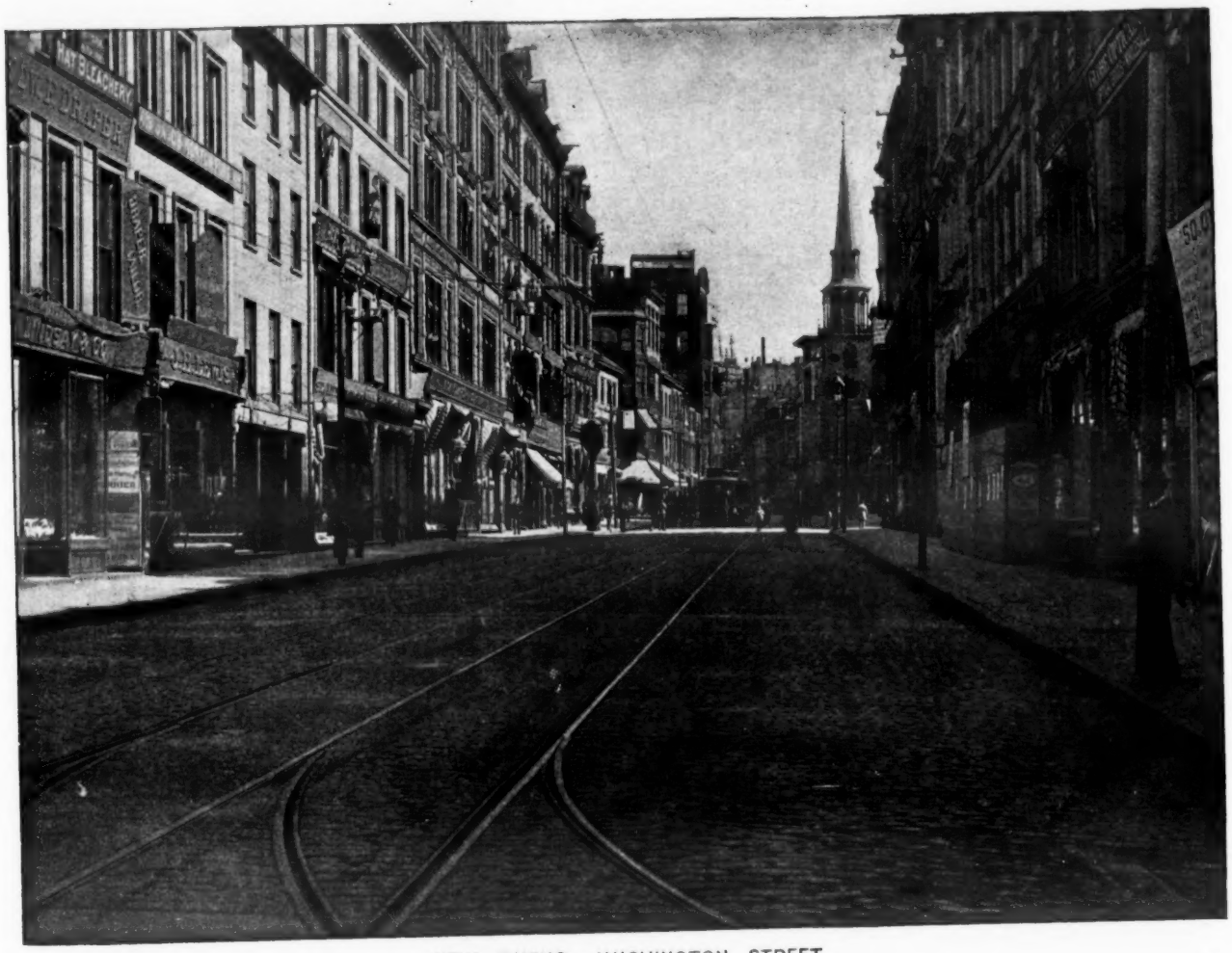
Some of the brick pavements laid in 1891 are commented on unfavorably by the city engineer, chiefly for the reason that a very poor quality of brick was used. They were among the first put on the market by new companies, and were evidently imperfectly vitrified. Some were not paving brick at all, but fire-clay brick, which should not be used for street paving. The remarks of the engineer are not to be taken as an indication of the general experience with brick. The engineer says:

"While the experience with brick paving in Boston is not encouraging, yet there is much being done in the way of producing better paving brick, and doubtless progress has been made in the last three years, and it is recommended that limited areas be paved with the best procurable bricks on a concrete base.

"The experience of other cities on this subject is not to be ignored, since many attempts have been made to put brick paving on a surer basis. The results of investigations of our own engineers seem to agree with the reports of special committees of some other cities, to the effect that while, in form, brick paving is commendable, both as to cleanliness and sanitary features, yet it can not be fully relied upon in large cities, where the traffic is heavy.

"It has given the best satisfaction in the smaller cities, and its principal weakness has been in the failure to produce the exact degree of vitrification and uniformity required to build a street that is impregnable throughout the entire length. Useless and costly experiments of trying to use bricks made from clays that are incapable of vitrification are unwarranted; but, taking advantage of the experience of Philadelphia, Wheeling, Newark, Columbus, Cincinnati, Kansas City, Quincy, Galesburg, Rock Island, Davenport, Detroit and other cities noted for their brick paving, the right clay may yet be found that will stand the test of absorption, abrasion, compression, vitrification, and the more practical tests of actual street wear."

Referring to other materials, the superintendent of streets says: "Asphalt blocks wear during cold weather by spalling off corners and leaving the blocks rounding on the tops like old granite blocks; when warmer weather comes, the blocks soften and flatten under



NEW PAVING — WASHINGTON STREET.

the traffic, and the streets appear in much better condition than earlier in the season."

In 1891 Boston put down both Trinidad and Sicilian rock asphalt pavements. The superintendent of streets says that it is difficult to distinguish any difference between them in appearance, and that one is not noticeably more slippery than the other.

The superintendent of streets strongly advocates putting granite block paving on a cement concrete base and pitching the joints. He says: "The advantage of the concrete base is beyond dispute, while the practical superiority of the pitched joint over the gravel joint may be stated in two essential particulars: first, a newly laid pitched pavement can be opened up for travel at once, in absolutely clean condition, in contrast to the former method of covering off with gravel that must require months of travel to grind it into the joints, while in the meantime the alternate mud and dust thus created is a source of annoyance and discomfort to the abutters; and, second, the tight joint prevents the surface-water from leaking through into the sand-bed and washing it out from under the blocks, and thus causing them to settle. Neither should the point be lost sight of or ignored that if the street wash is carried at once by an impervious pavement and gutter directly into the catch-basin, and thence into the drainage system, the sanitary condition of the street is immediately changed. No longer can there exist the process of fermentation and putrefaction of the confined masses of stagnant street liquids, animal and vegetable matter, that fill every crevice and hollow between and under the blocks where joints are left open. If such a source of danger to the public health can be thus removed, the benefits received more than offset the temporary annoyance of the tar-kettle and the additional cost of the pitching. Large blocks have been preferred, measuring in width from three and a half (3½) to four and one-half (4½) inches; in length, from nine (9) to fourteen (14) inches; and averaging not less than eleven and one-half (11½) inches; and in depth, from seven and one-half (7½) to eight (8) inches. They have cost seventy-three and one-half dollars ($73.50) per M., delivered on the wharves."

PETROLEUM IN ITS RELATIONS TO ASPHALTIC PAVEMENT.

THE earliest analysis of petroleum is described by de Saussure in a paper published in the Bibliothéque Universelle in 1817.* He examined the so-called naphtha of Amiano, a very light and almost colorless petroleum. He purified it by distillation and determined the percentage composition, as if it were an homogeneous substance. Twenty years later, in 1837,† Boussingault published his celebrated memoir on the composition of bitumens, in which he described his manner of separating, partly by distillation and partly by solution, what he supposed were two homogeneous substances from the petroleum, or more properly maltha, of Bechelbronn on the lower Rhine. He found that in making the separation by distillation it was necessary to keep the material heated in an air bath for from forty-five to fifty hours, and in a note makes this pregnant observation: "By this method it is impossible to estimate the two principles of the bitumen; as at this temperature (250° C.) a part of the petroline is oxidized and passes into the solid state, or asphaltine." These two substances, the petrolene or liquid part, and the asphaltine or solid part, into which nearly all bitumens may be resolved in varying proportions, have not received the attention which they deserve, partly because as chemical compounds they are without significance, and partly as they are separated from different bitumens, the petroline in particular, they have very unlike properties.

On visiting southern California in 1865,‡ all the natural phenomena attending the passage of petroleum through maltha into asphaltum, were witnessed upon a very extended scale, and I was forced to consider as matters of economic importance many problems that had not hitherto been brought to the attention of tech-

* Bibliothéque Universelle, iv, 116; Annales de Chemie et de Physique (2), iv 314-340; London Journal of Science, iii, 411.

† Annales de Chemie et de Physique (2), lxiv, 141; Journal of Franklin Institute, xxiv, 138; New Edinburg Philosophical Journal, xxii, 97.

‡ Geological Survey of California, Geology, ii, Appendix, p. 73; Reports 10th Census U. S., vol. x, Petroleum, p. 185.

nologists. In what manner the changes everywhere proceeding upon the surface were related to possible changes below the surface led me to imitate in every respect, save the element of time, the operations of nature as far as possible. I therefore proceeded upon a synthetic rather than an analytic line of investigation, and treated the unchanged oil issuing from deep-seated strata, to the action of air and ozone. As the action of these reagents might be explained as due either to the addition of oxygen or to the subtraction of hydrogen, I tried the effect of chlorine and found it to be in the main identical with that of the first named gases. The product of these reactions was a brilliant solid, apparently identical with pure asphaltum, and also with Boussingault's asphaltine.

In 1870 I stated the problem to Prof. J. D. Whitney as follows: "To discover, if possible, whether asphaltum is formed from petroleum by a change that adds oxygen or subtracts hydrogen, or both. To subject several typical varieties of petroleum to the action of ozone under conditions as nearly identical as possible. To study the residues of such action and establish the identity (if such identity exists) between the solid residues and native asphalts. To study the liquid and volatile products of such decomposition."

Since 1870 Le Bel and Muntz* (1872) have treated Syrian asphalt and several other forms of bitumen to the solvent action of ethylic-ether. Ethylic-alcohol was then added to the solution and the bitumen precipitated. The solution and precipitation were repeated until the precipitated bitumen was quite pure. It appears as a brown powder. From solution in carbon disulphide it appears in brilliant black scales, which are insoluble in light petroleum naphtha (paraffines) but dissolve in the heavy distillates, which fact readily accounts for the difference in color between the light and heavy natural oils. These authors remark that "Its (asphaltine) presence in natural bitumens proves that they have not been submitted to distillation, nor even the action of a high temperature, which corroborates the most generally received opinion respecting their origin, that they have been directly derived from coal or lignite."

Subsequent research by Le Bel showed that a resinous substance remained dissolved in the ether that was readily acted on by sul-

* Bulletin de la Société Chemique de Paris, xvii, 156.

phuric acid. Distillation converted it into a residue of carbon, light oils and gas. These light oils when treated with iodohydric acid yielded compounds of the olefine series.

Later, Cabot* discovered that paraffines subjected to the action of sulphur at temperatures above their boiling points were converted into hydrogen sulphide and carbon. At about the same time Jenney† aspirated air continuously for forty or more hours through refined illuminating and lubricating oils, in presence of litharge and at a temperature of 100° C.–140° C. By this means he converted a portion of the oil into a solid oxidized residue, a portion distilled into the receiver, and a portion remained in the retort. These residues were either brilliant black solids or brownish flocculent precipitates, which were all soluble in carbon disulphide.

Lastly, I have lately found that a heavy fraction of a distillate, that was a transparent mobile fluid, obtained by distilling California petroleum at nearly a red heat, when left to stand in an open Becker glass for from 12–14 months, had become so charged with asphaltine that the addition of petroleum naphtha or any of the liquids in which asphaltine is insoluble, at once produced a brown flocculent precipitate. This observation completely contradicts the conclusion reached by Le Bel and Muntz, as stated above, that natural oils containing asphaltine could not have been distilled or subjected to high temperatures.

These researches show that the soluble and fluid portions of bitumens are converted into insoluble and solid forms, that may or may not contain oxygen, either by prolonged action of air and other oxidizing agents at ordinary temperatures, or at higher temperatures. They also show that the same effects are produced without the action of reagents by prolonged heating alone, and the familiar process in technology known as "cracking" is a further illustration of the tendency of bitumens under the influence of heat alone to break up into one series of compounds richer than the original in hydrogen and another compound or series of compounds richer than the original in carbon.

Now within a few years and since all of this work was completed,

* American Chemist, vii, 20; Chemical News, xxxvi, 114; Wagner's Berichte, 1876, p. 1110.

† American Chemist, v, 309; Wagner's Berichte, 1875, p. 1060.

the laying of asphalt pavements has become an industry involving the expenditure of vast sums of money and consequently presenting technical problems of vast importance. The technology proceeds about as follows: A quantity of asphaltum is brought to New York from Trinidad. This asphaltum consists of water, 27 per cent.; inorganic matter, consisting of fine aluminous sand, 27 per cent.; organic matter, insoluble in carbon disulphide, 8 per cent.; bitumen, 38 per cent. This crude asphaltum is put into large open kettles and melted, the temperature being raised and maintained for some time in the neighborhood of 400° F. By this treatment the wear and lighter oils are expelled, and a portion of the mineral matter sinking out of the melted mass to the bottom of the kettles, a "refined pitch" is left, which is drawn off. This "refined pitch" consists, in round numbers, of 56 per cent. of bitumen, 36 per cent. of mineral matter and 8 per cent. of organic matter not bitumen. Of the 56 per cent. of bitumen, 36 per cent. is soluble in petroleum naphtha, leaving 20 per cent. that may be obtained from solution in carbon disulphide in brilliant black scales. Properly interpreted the refined pitch consists of:

Petroline		36 per cent.
Asphaltine	20 per cent.	
Organic matter not bitumen	8 "	
Mineral matter	36 "	
	64 "	36 "

Sixty-four per cent. of material without cohesion; that is, dry solids for the most part, are held together by 36 per cent. of a viscous adhesive tar. The 20 per cent. of the asphaltine dissolves in the petroline, the remaining 44 per cent. being simply mineral and organic matter held together by the combined bitumens

The next step in the process is the addition to the refined pitch of about 15 per cent. of its weight of some heavy petroleum residuum, which renders the bitumen softer, and at the same time may or may not dissolve both petroline and asphaltine. The mixture is made complete by blowing air through the melted mass for hours or even days. Sand is then added to the bituminous cement until the bitumen is only equal to 10 per cent. of the mass. To incorporate the sand with the viscous mass, both are heated very hot and

the sand and bitumen thoroughly mixed, when the mastic thus produced is put in its place and rolled.

Very great diversity is observed in the durability of the mastic thus prepared and laid, and to account for these diversities Mr. Clifford Richardson* would have us believe that it depends on the excavation on the Island of Trinidad from which the crude asphalt was taken. So too the Hon. Commissioner of Public Works of the City of New York, by the advice of Stevenson Towle,† Consulting Engineer, has reached a similar conclusion. Speaking of the Eighth Ave. pavement, a part of which "showed indications of disintegration" before it was accepted Mr. Towle, says, "the asphalt used in this work was submitted by the contractor and analyzed and approved by chemical experts;" and yet, farther on in this same report, it is stated that the asphalt was condemned because it was taken from one excavation on the island rather than another.

It is a very significant fact that an asphalt pavement should show signs of disintegration within a few weeks of the time of its having been laid. Especially is this the case when it is considered that some of the most enduring constructions of antiquity, which have withstood the ravages of time for at least 3,000 years, are constructions of asphalt. Modern constructions of asphalt in Europe are said to remain intact for more than twenty years. The asphalt pavement laid upon Franklin Avenue, in the City of Buffalo, has stood, with almost no expense for repairs, for fifteen years, and I do not believe any one now knows from what exact spot the asphalt came. It is a very well known fact however that the material used to soften the asphalt was one that would dissolve both constituents of the bitumen, and form a chemical union or solution rather than a mechanical mixture with them. No one knows how old the asphaltic sandstones are that contain 10 per cent. of bitumen, but they do not disintegrate; they are solid, impervious and tough.

If sand could be cemented together with carbon, it would only be necessary to grind up anthracite slack and mix it with sand in order to produce a paving material. It is evident that the hydrogen

* Report of the operations of the Engineer Department of the District of Columbia for the fiscal year ending June 30, 1892, pp. 96–123.

† Report of the Department of Public Works of the City of New York on Street Pavements, with special reference to Asphalt Pavements. Thomas F. Gilroy, Commmissioner. 1892. Pages 9 and 11 *et seq.*

combined with the carbon gives it adhesive properties, and this within certain limits, for the moment a sufficient amount of hydrogen is removed to convert the petroline into asphaltine, or whenever the softening material is a petroleum or residuum that will not dissolve asphaltine, the elements of disintegration are present.

The observation made by Boussingault more than half a century ago, and quoted above, that prolonged heating at high temperatures converts petroline into asphaltine, which has no more adhesive properties than anthracite slack, appears to have been overlooked by Messrs. Richardson and Towle, for they do not appear to regard the manner of refining and blowing the asphaltic cement as of any importance. Neither for the same reason do they appear to appreciate the bearing of my own researches or those of Messrs. Cabot and Jenney upon this question, although they have been on record now more than twenty years. While it has been well known for years that bitumens occur in great variety, the selection of a proper material for softening the asphalt to the exclusion of others less desirable or wholly unfit, appears also to have escaped attention. A properly selected material for such a purpose would by entering into solution and chemical union with both the constituent parts of the bitumen of the asphalt, thereby increase its adhesive and binding properties upon the other constituents of the mastic. Added to all these omitted elements of the problem just enumerated, we have another of great importance, and that is the total proportion of bitumen to the total proportion of sand and other non-bituminous ingredients of the mastic. Experience proves that less than 10 per cent.–11 per cent. to 90 per cent.–89 per cent. gives too little stability to the mass, while a larger percentage of bitumen makes the pavement too soft.

One more element of a good asphaltic pavement is mechanical rather than chemical, and that is solidity. The pavement must be rolled as solid as asphaltic rock in order to keep out rain water and the action of the oxygen dissolved in it; for the effect of oxidation is to gradually convert the petroline of the asphalt into asphaltine, leaving the small amount of softening material as the only binding constituent of the mixture. When this softening material is not a solvent for asphaltine the pavement inevitably disintegrates.

I would therefore commend to the consideration of those who

act as advisers to commissioners of public works, not a less careful examination of the asphalt used, from whatsoever source it may be obtained; but in addition an equally careful exercise of judgment regarding the softening material used, the chemical effects of refining and blowing, with careless management of either, and the composition and mechanical structure of the surface pavement.

It is far from complimentary to this age of scientific achievement that the ancient world should have furnished constructions of asphalt that have survived to the present, centuries after their builders are forgotten, while, with all our superfluities of refining and blowing, with penetrating machines and chemical analysis, of which they knew nothing, we are only able to prepare constructions that endure but a few months or even years, at longest.

I am aware that this paper is inconclusive, but from the nature and present status of the problem it must be so. I think, however, it is, as it was intended to be, suggestive. *S. F. Peckham.*

CURRENT INFORMATION.

A NEW PLAN FOR SEWER ASSESSMENTS.

Mr. F. Herbert Snow, city engineer of Brockton, Mass., has made a valuable contribution to the literature of improved municipal government in his report on the subject of sewer assessments, which has just been published. It is a thorough and exhaustive treatment of the subject from every point of view. Mr. Snow points out the objection to the plans of assessment which are now commonly in operation, showing the inequalities or unfairness which is very likely to result from them. He believes that under any plan land should not pay the whole cost, any more than it should bear the entire taxation for purposes of schools or water-works. He holds that the benefits of sewerage can not be calculated in the ratio of valuation of real estate. A feature of the plan which he proposes is that an assessment shall be based upon water consumption. The objection to the plan, which at once comes to mind, is, as Mr. Snow states, a possible danger of limiting the amount of water to an extent insufficient for cleanliness and proper flushing of the sewers. He thinks, however, that assessments based on meters would not have any appreciable effect on the sanitary condition of dwellings or other buildings. He argues that, under this plan, there should be a discount for water that, ordinarily, is not expected to reach the sewer, and that there should be a charge for meter connections equal to the rates for the probable amount of water used. His consideration of the whole subject leads up to these propositions: First, a user of a sewer receives a direct benefit; second, an abutter may sell his vacant land at an increased price, and third, a farmer or other occupant of land outside the sewer district may derive advantages therefrom. To meet these betterments, the following scheme is proposed: That one-half of the total cost, including maintenance, be raised by rental assessed on the user; one-fourth by first assessment on abutting land, vacant or otherwise, and the remainder, approximately one-fourth, by general tax levy. Under this plan one-half would be raised on the basis of charges for the consumption of water; one-fourth by assessment of land, and, as stated, the remainder by general tax levy. The plan contemplates the issuance of bonds to raise the amount required to pay for the construction of the sewers, and the fund for the retirement of the bonds is derived from the rental assessments and taxes provided for in the distribution of the burden of expense. The plan is certainly worthy very careful consideration.

STATE SUPERVISION OF WATER-WORKS AND SEWERAGE SYSTEMS.

Some of the smaller towns of the State of Ohio have been disposed to overlook the law which requires that before a water-works or sewerage system is introduced the plans

therefor shall be approved by the State Board of Health. The law was passed to benefit the residents of municipalities by insuring them a supply of pure water, but it is objectionable to officials for the reason that it takes from them the power to do what they please. The tendency to ignore the law has become so serious that Dr. Probst, secretary of the State Board of Health, made a formal inquiry of Attorney-General Richards as to what could be done. The attorney-general in his reply stated that the State Board of Health has power to make use of the courts in compelling the officials to obey the law. He holds that water-works or sewerage bonds issued in disregard of the law requiring the approval of the State Board of Health, as stated, are not invalidated thereby.

STREET-CLEANING PLANS IN SAN FRANCISCO.

The Merchants' Association of San Francisco is endeavoring to secure for that city a better system of street cleaning, and is engaged in formulating plans for the improvement of the present system. The street committee of the board of supervisors has consented to prolong the present contract sixty days from July 1st in order that the plans to be adopted by the association may be before the supervisors before the advertisements for bids for the next two years are published. In the meantime, as a practical experiment, the association is having a section of the retail part of the city kept clean during the day by hand labor, for which they are charging the merchants doing business on each block 10 cents per day for single stores of not more than 25 feet frontage, and in like proportion for larger establishments.

STREET-WATERING IN BOSTON.

The city of Boston is now watering twenty-nine and a half miles of paved streets by contract at the expense of abutting property owners. Superintendent of Streets Carter reports that under this method a nuisance is frequently created. The contractors are unable to collect their money from subscribers until the end of the watering season, and if complaint has been made on account of dust, there is frequently a dispute concerning the payment of the stipulated amount. The contractors are, therefore, very careful to avoid this trouble, and prefer to deluge the streets with water so that no possible dispute can arise concerning the payment of their bills. In this way the streets are kept excessively wet, and it becomes difficult to clean them. To remedy this the department has prohibited the wetting of streets after four o'clock in the afternoon so that they have a chance to dry properly before the night sweeping.

SCIENTIFIC INSTRUCTION IN CLAY WORKING.

During its recent session the General Assembly of Ohio authorized, by special enactment, the creation of a course of "Practical and Scientific Instruction in the Art of Clay Working and Ceramics" in the Ohio State University, and funds were appropriated for establishing and maintaining such a course of instruction. Mr. Edward Orton, Jr., of Columbus, has been elected director of the new work and to him is entrusted the preparations for opening the department at the beginning of the ensuing college year. The work for the first year comprises elementary instruction in mathematics, physics and chemistry. The second year

is given to the continued study of chemistry and to geology and the theory and practice of clay working, and the third year to the analysis of glazes, slips and enamels. The work is so adjusted as to keep pace with the lectures and laboratory work in clay working, and will be conducted in the same room. Special facilities are offered for the study of clays and clay working, which comprise all of the typical and common forms of machinery for the preliminary preparation of clays, for the mixture and temperature of clay bodies and for molding and forming all classes of wares. Models and drawings of drying apparatus, models and drawings of kilns, and several small kilns of different types arranged to burn test brick and pottery to determine melting points of refractory clay will be provided. For burning such work as can not properly be executed in miniature, access has been promised to the large kilns of several Columbus clay works. The proposed course of instruction is an entirely new departure in the educational fields of the United States.

THE CONVENTION OF BOARDS OF PUBLIC WORKS.

The call for the proposed convention of boards of public works has been issued, and is as follows:

To the Honorable Presidents and Members of Boards of Public Works of the Various American Cities:

We, the undersigned members of the boards of public works of the several cities below mentioned, hereby urge the calling of a convention of the members of these boards, believing that much valuable information may be gathered by each member of this convention, and seeing the very evident benefits to be gained by a meeting of this kind and such an interchange of ideas on the subject of public work.

ROBT. E. MCMATH, President,
M. J. MURPHY, Street Com'r,
M. L. HOLMAN, Water Com'r,
R. R. SOUTHARD, Sewer Com'r,
DAN ABLE, Harbor and Wharf Com'r,
JNO. P. FECHTER, Park Com'r,
Board of Public Improvements,
St. Louis, Mo.

AARON KOHN, President,
JOS. NEVIN,
JNO. L. DUNLAP,
Members Board Public Works,
Louisville, Ky.

J. H. WINSPEAR, President,
ST. A. D. BALCOMBE,
JOHN B. FURAY,
Members Board Public Works,
Omaha, Neb.

G. H. BENZENBERG, President,
FRED SCHNEIDER,
S. J. BROCKMAN,
E. M. SCHUENGEL,
Members Board Public Works,
Milwaukee, Wis.

JOHN W. ROSS, President,
District Columbia, Washington, D. C.

HENRY H. CARTER,
Superintendent of Streets, Boston, Mass.

AUG. HERMAN, President,
JOHN B. WASHBURN,
JOHN FRY,
Members Board Public Works,
Cincinnati, Ohio.

ARTHUR C. HARRIS, President,
THOMAS B. BUCHANAN,
C. W. RHODES,
Members Board Public Works,
Denver, Col.

PETER FARRELL,
Commissioner Public Works,
New Orleans, La.

H. B. JOHNSON,
Commissioner Public Works,
Syracuse, N. Y.

The board of public works of Buffalo has invited the proposed convention to meet in that city, and has promised to do all in its power to make the meeting a success. A majority of the signers of the call preferred Buffalo, on account of the geographical location and the advanced public work that has been done there. The convention, therefore, will be held in Buffalo, and Wednesday, September 19th, is the date fixed for the meeting. Members of boards intending to be present are urged to prepare in advance data pertaining to their work.

VIEWS OF MILWAUKEE'S MAYOR REGARDING STREET PAVING.

While en route to Niagara Falls to attend the annual meeting of the American Society of Civil Engineers, Mayor John C. Koch and G. H. Benzenburg, of Milwaukee, stopped off at Detroit for the purpose of examining the Bermudez asphalt pavements that have been put down in that city. As a result of their examination Milwaukee will, hereafter, invite competition in street paving. Both gentlemen felt that they had obtained valuable information regarding pavements. Mayor Koch said :

" I am satisfied of two things in regard to pavements. In the first place the foundation must be properly constructed. The best surface paving in the world would fail with a poor foundation. Another essential is the care to be exercised in keeping the pavements in repair. Most pavements are ruined by neglect. Accidents will happen or there may be an unseen defect. Unless it is repaired in time the ruin is complete. I just happened to get to Buffalo in time to watch some repairing of asphalt paving on Main street. It seems that the paving had settled about a quarter of an inch in the gutter so that pools of water stood in several places. It was being taken up and raised to the required level. At first I was apprehensive that asphalt paving could not be repaired very well, but I am now convinced that it can be repaired even better than other kinds. I saw places where the repairs could scarcely be detected so well were they done.

" I am no longer in doubt regarding the best kind of general paving that should be put down in all parts of the city. As a matter of fact there is only one kind of paving that will prove serviceable for a long time. It is the concrete base with cedar blocks covered with liquid cement. The concrete base should be six inches thick and the cedar blocks should be covered with liquid cement. That completely preserves the wood and prevents the water from running anywhere except into the gutter. I will insist on this kind of paving everywhere except where the asphalt is put down.

" There is a question connected with asphalt paving that we must settle, and that is in regard to the width of tires on heavy wagons. In Buffalo I did not see a narrow tired traffic wagon and their pavements are in excellent condition. I understand that we have an old ordinance on this subject that requires the tires on all heavy wagons to be at least three inches wide. We will have to revive the ordinance and compel the use of wide tires. This will be a peremptory order that everybody will have to obey."

HARDSHIP ON CHICAGO CONTRACTORS.

An opinion has been delivered to Comptroller Ackerman by Assistant Corporation Counsel Zeisler, at Chicago, regarding the payment of contractors for city work. It has been the custom of the city for years to pay contractors from time to time as their work progressed. The full value of the work has never been paid, although the contractor was able to get a large portion of it, after an examination of the work by the city engineers, who gave an estimate as to the worth of the work. The city holds back a certain percentage after the work is completed, to cover the cost of repairs. From time to time the con-

tractor has been given interest-bearing vouchers for such money as is due on contracts and which the city has no money to pay. The contractor has been able to discount these vouchers, thereby getting money with which to carry on his work. The opinion recently given, however, puts a stop to this. In brief, it is to the effect that no payment may be made on any work under contract until the entire work is completed. The plan proposed is looked on with disfavor by Mayor Hopkins, Commissioner Jones and many of the paving contractors, who claim that contractors can not do work under the plan of Mr. Zeisler. It is regarded as very unfortunate for the interests of the city.

A SUBSTITUTE FOR MACADAM IN NEW YORK.

Mayor Kennedy, of Kingston, N. Y., expresses the opinion that if the streets of that city were filled in with cement cinders for a foundation, top-dressed with fine bluestone and rolled, they would be much better than they are now and the expense of macadamizing would be considerably lessened. For a number of years the top-dressing has generally been done with limestone, which, when rolled, makes a good roadway for a while, but constant use and the action of the air is said to gradually turn the surface of the streets to powder in dry weather and to mud in wet weather. Cement cinders can be delivered on the streets of Kingston at very low cost, and any quantity can be procured from the cement kilns about the city. A thorough test has been given the durability of bluestone on a block of Broadway, between St. James and Elmendorf streets, which, four years ago, was top-dressed with bluestone and rolled, and, although considerable loose stuff has been allowed to remain on the surface, it has worn remarkably well.

A PROPOSED PLAN FOR STREET PAVING IN DENVER.

A plan, submitted by the committee on public institutions and improvements at a recent meeting of the directors of the Chamber of Commerce, Denver, Col., for paving extension, was unanimously adopted. The plan is to extend, from the central business section of the city which is completely paved, the asphalt on main thoroughfares reaching in all directions through the residence districts, in order to give each one an outlet down town on paved streets. Streets have been selected as much as possible through which electric or cable roads run, and the companies will have to pay their share of expense.

A COMMITTEE'S REPORT ON BRICK PAVING.

A committee was appointed by the council at Poughkeepsie, N. Y., to visit various other cities and inspect brick pavements. The substance of the report is as follows:

Syracuse.—We learned that the brick on the streets that we saw had been laid from three to six years, partly upon broken stone and partly upon concrete foundations. The pavements generally seemed to be in good condition, but some of the bricks were chipped on their faces.

Dunkirk, N. Y.—Central avenue, the first street paved with brick, is about a mile in length and is forty-five feet in width between the curbs. The pavement on this street was the finest we saw anywhere. The brick had been laid between four and five years and

showed hardly any wear at all, and on some parts of the street the pavement was as smooth as sheet asphalt.

Pittsburg, Rochester and Beaver, Pa.—We found the clay used to be the best of its kind and the brick all seemed to be carefully burned. From Pittsburg we went to Rochester and Beaver, Pa., where we saw the Park brick laid on some very steep grades, where they showed excellent wear. These pavements were all laid on broken stone and sand foundation. On some of these streets, where teams often haul loads of 7,000 pounds the grades are as steep as 10 or 12 feet to the hundred.

Canton, O.—On several of the streets that we examined the brick were laid on broken stone and sand with tar filling. The brick were somewhat chipped on their faces, and the streets were mostly of level grades.

Johnstown, Pa.—We examined a number of streets laid with different kinds of brick. The pavements in this city did not show good wear, the brick being badly chipped on their faces. We met Mr. Weir, the city engineer, who informed us that the different kinds of brick heretofore laid in Johnstown had not given good satisfaction.

The report of the committee closes with the following recommendations:

"We would recommend that in all work done in Poughkeepsie special care be taken in laying the pavement on streets in which street railway tracks are laid. Concrete should be laid both under and around the ties, as we are satisfied that both the public and the railway company will be very materially benefited thereby. We found that in instances where the concrete was not laid as above mentioned, the brick for a distance of about 18 inches from the rail were thoroughly unsettled, and not only presented a very bad appearance, but were detrimental to the durability of the pavement and to comfort in traveling, both in the street cars and in carriages."

INTERSTITIAL FILLING OF BRICK PAVEMENTS.

A peculiar complaint was recently made to the street committee at Buffalo, N. Y., regarding the pavements on Tryon Place, Danforth street and Dart street. Syracuse vitrified brick were used in the construction of these pavements, in 1892–3. The specifications called for the filling of the joints "with coal tar paving cement, known as No. 4, which must be heated and poured at a temperature of not less than 300° Fahrenheit, filling the joints full, after which, and while the pitch is hot, coarse clean sand be spread on the surface of the pavement to the depth of one-half inch."

The recent hot weather caused the tar to melt and, it is claimed, run into the gutters like water. Some time ago, a resolution was introduced by Alderman Smither, who heads the residents of the streets in their complaint, calling upon the board of public works to make a careful inspection of these streets to see if the interstices had been filled with the proper material, and if not so filled, to have the material removed and replaced at the expense of the company who did the work. This course could not be adopted, however, as the pavements were constructed according to the specifications. Alderman Smither says that the board of public works practically admitted that a mistake had been made in allowing tar to be used, and had

since called for cement. He declares that his constituents are entitled to some redress, as they had depended upon the board of public works to give them a good pavement and had been disappointed.

THE KIND OF PAVING PREFERRED BY PHILADELPHIA GROCERS.

A committee, representing the Retail Grocers' Association, called upon Director Windrim, at Philadelphia, July 2, and presented resolutions asking that all the streets to be paved with asphalt have either vitrified brick or Belgian blocks laid between the car tracks, and that all future paving or repaving within the city limits be so arranged that every other street shall be paved with vitrified brick or Belgian blocks, or some like material, which will secure a safe footing for horses in icy or frosty weather. Director Windrim is reported as expressing himself entirely in accord with the views of the Grocers' Association regarding the paving of the most frequented thoroughfares.

VITRIFIED BRICK RECOMMENDED FOR LIGHT TRAFFIC STREETS IN ST. LOUIS.

A recent report of the St. Louis Board of Public Improvements recommends vitrified brick pavements for residence streets and for light traffic streets. Where hauling is heavy, granite pavements are recommended. The annual cost of keeping granite pavements is estimated by the board at 15 cents per 100 square feet; the cost of asphalt, $1.05 per 100 square feet. Streets constructed of macadam and wooden blocks, while the first cost is very low, are very expensive in time, the board says, because not durable.

FOUNDATIONS FOR BRICK PAVEMENTS IN PHILADELPHIA.

Regarding the foundation for vitrified brick pavements, the Philadelphia *Ledger* says:

"About ten years ago the first vitrified brick pavements were laid in the outlying districts of our city, where they at once became popular, and apparently are yet held in the highest esteem. From the beginning they were admired for their beauty and comparative noiselessness. They were also soon found to be the easiest of any material ever introduced to keep clean, and they were almost entirely free from the clouds of filthy dust which is one of the bad features of some other improved pavements. Moreover, as time passed, this material was found to be quite as durable as its friends had claimed that it would be. At first laid as a substitute for macadam, it, in many cases, was compared favorably with the Belgian block, and often property owners asked for bricks in preference.

"When first laid, and until a year or two ago, whenever vitrified bricks or Belgian blocks were to be laid, there was a clause in the specifications that the foundations should be of gravel of good quality, and sometimes, on the approval of the bureau of highways, rotten rock sand was permitted as the underlying material. These specifications gave general satisfaction, but a year or two ago, on the plea that it was desirable to put down pavements that would endure for all time, a proposition was introduced into councils that in the future the foundation of all paving material should be concrete. To this the *Ledger* took exception.

"At the last meeting of the highway committee this feature was brought to the attention of the

members while the question of paving certain streets was being considered, and the point was further emphasized by a contractor who offered, if rotten rock sand, of the quality formerly permitted, could be used in place of concrete, to put bids in at the old rates, and give bonds to keep the streets named in repair for ten years, or, if required, for even a longer period. As the contractors under the present specifications only need keep the streets in good condition for five years after the pavement has been laid, this, together with the other statements made, caused the highway committee to report favorably the ordinances permitting the use of rotten rock sand."

NEW SPECIFICATIONS FOR BRICK PAVING.

New specifications for brick paving have been prepared by City Engineer Filley, at Kansas City, Mo., in accordance with suggestions made by Mr. Gage, of the board of public works. Additional tests will be provided and the new specifications will be much more rigid and will replace those in use heretofore.

REPORTS OF MUNICIPAL OFFICERS.

The annual report of L. E. Browne, city civil engineer at Richmond, Ind., shows the public work in that city for the past year, as follows: 15,738 lineal feet of sewers, $63,088; 14,193 lineal feet of sidewalks, $6,650; 16,984 lineal feet of streets improved, $97,950; 1,851 lineal feet of alleys improved, $1,913. Compared with last year's report, this shows an increase of four times the amount of work done last year. A summary of Richmond shows that of 60 miles of streets, 43 miles are improved, and that the city has 11½ miles of sewers.

The annual report of Henry Kelling, city clerk at Walla Walla, Wash., for the fiscal year ending June 30, 1894, shows an expenditure in the street department of $10,314.80. This includes the general improvement of bridges, cross walks and streets.

THE GOOD ROADS CONFERENCE.

The recent good roads convention held at Asbury Park, N. J., was attended by representatives of forty states, who unanimously declared the need for good roads and the decided benefits to be derived from a better plan of building and maintaining them. General Roy Stone, engineer of the government bureau of roads, George C. Perkins, of the Massachusetts State Board of Highway Commissioners, and others, pointed out the necessity for more general organization, recommended legislation in its behalf and the establishment of chairs of instruction in highway engineering in our colleges. The convention recommended that plans capable of general adoption be outlined and state highway commissioners be appointed by the different states to supervise the construction of a system of good roads.

OKLAHOMA ASPHALTUM.

A chemical analysis of the asphaltum deposits of Chickasaw county, Oklahoma, shows its composition to be as follows:

Carbon	55	per cent.
Hydrogen	10.21	"
Oxygen	7.14	"
Nitrogen	2.74	"
Silicate and ashes	24.91	"

The bed seems to consist of a layer of asphaltic sand, which overlies a bed of viscid bitumen, which is very sticky and difficult to extract.

It will be developed by an Oklahoma company, which will put both the liquid asphaltum and the bituminous sand on the market. It is reported that the company can put the liquid asphaltum on the cars for $17 per ton and the asphaltic sand for $8 per ton.

JOHN JACOB ASTOR'S VIEWS ON STREET PAVING.

John Jacob Astor, for his own information and on account of his property interests, has investigated street paving, and when interviewed on the subject by the New York *World*, said:

"There is no question as to what is the best material for street pavement. I am convinced that every street in the city should be paved with asphalt. It is smoother, stronger, more healthy and a great deal easier taken care of than any other pavement yet invented. The wear and tear on vehicles driven over asphalt pavements is reduced to a minimum. So much is this the case that were it only known and appreciated, owners of vehicles of all kinds, from the heavy truck to the light pleasure wagons, could afford to pay for paving the streets with asphalt, as the saving to them on repairs would more than reimburse them."

PAVING BRICK MADE IN THE SOUTH.

Much attention was directed to the general appearance of a car of paving brick that recently stood in the railway tracks at Montgomery, Ala. The car was en route to Jacksonville, Fla. They were of a fine general appearance, well made, of good average size, and when broken presented a hard even texture, and while many are somewhat red most of them are of a uniform black. The difference in the color of the brick is said to come from the presence of iron which varies in some more than in others. The clay from which the brick are made is dug from a bank where it lies in stratas, and where the iron shale predominates in one kind more than in another, the difference in color is the result, although the hardness and durability of the brick are not affected.

PERSONALS.

Mr. James Lawler has been appointed engineer of the waterworks at Rushville, Ill.

The common council of Madison, Wis., has ordered an investigation of the city's sewerage system.

F. W. Farquhar has been appointed consulting engineer of the Plainfield sewerage construction, at Plainfield, N. Y.

W. W. Jeffers, assistant state engineer of New York, has begun a survey for a system of sewers for Ticonderoga, N. Y.

The plan of sewerage prepared for Woodbury, N. J., by Waring, Chapman & Farquhar, of Newport, R. I., has been adopted by the city council.

W. S. Shields, C. E., Chicago, Ill., is superintending the lowering of the pumps and the erection of the new pump house at Huntington, Ind.

Mr. George W. Robinson, Jr., senior member of the firm of George W. Robinson, Jr., & Bros., brick manufacturers, died July 5, at his home in Baltimore, Md.

Olin H. Landreth, C. E., Nashville, Tenn., has been employed to draft plans and superintend the construction of a system of waterworks and an electric plant at Crowley, La.

Messrs. George R. Foster, Jr., and and George Crawford were recently appointed inspectors of the Coaldale brick to be used in the Main street pavement at Jacksonville, Fla.

A party of officials of Niagara Falls, consisting of Mayor D. Phillips, Aldermen John C. Stricker, James J. Mahoney, John Wagner, J. J. Maloney, James O. Banks and John B. McKenna, and George W. Wright, of the board of public works, recently visited Columbus, Cleveland, Youngstown and Steubenville, O.; New Cumberland and Wheeling, W. Va.; Rochester, Beaver Falls, Pittsburg, Beaver Dam and Dunkirk, Pa., investigating paving brick and street pavements.

F. A. Warren, cashier in the Kansas City office of the Barber Asphalt Company, has gone to New York to accept the position of assistant general auditor in the company's general office.

A CORRECTION.

In Prof. De Smedt's reply to Capt. Torrey, in the July, '94, issue of PAVING AND MUNICIPAL ENGINEERING, the word *sulphuretted* was used in two different places, one on *page 11, first paragraph*, and the other on *page 12, near top*, instead of the word *sulphurated*.

LETTERS FOR THE PUBLIC.

THE AVERAGE OF ANALYSES OF CRUDE TRINIDAD ASPHALT.

To the Editor of Paving and Municipal Engineering:

The following may interest many readers as the best average analyses of crude Trinidad asphalt known to me.

Crude Trinidad asphalt is dark brown and brittle at ordinary temperatures. It is easily detached from the surface of the "Asphalt Lake" with a pick. Its irregular fracture shows particles of clay and vegetable matter in it. When warmed in the hand it can be slightly bent. When broken it emits a bituminous odor. It is very porous. The chemical and physical tests are easily made. The average analyses of crude Trinidad asphalt are as follows:

First—By weighing, then driving off the water. Authority. Richardson.

Water	27.85
Asphalt, earthy and vegetable matter	72.14
	100.00

Second—By analyzing the dry crude asphalt.

Asphalt	52.87
Earthy and vegetable matter	47.13
	100.00

Third—Combining the results gives the average analysis of crude Trinidad asphalt.

Asphalt	38.14
Earthy and vegetable matter	34.01
Water	27.85
	100.00

Finally—The complete analyses of the materials contained in crude Trinidad asphalts are as follows:

Authority,	Bowen.	Richardson.
Asphalt	39.83	38.14
Earthy matter	33.99	26.38
Vegetable matter	9.31	7.63
Water	16.87	27.85
	100.00	100.00

These are natural mechanical mixtures. The variation of water is very great. A lump of crude asphalt in a room loses its water in a few weeks. Powdered crude asphalt loses its water by evaporation in a few days. Samples of asphalt from the center of the "lake" vary slightly from those near the shore. But for commercial uses the asphalt from within the asphalt lake is more constant, reliable and better than that which, for a short time,

came from places outside the "lake," and was known as "overflow or land pitch." This material contained many variable impurities, and lacked cementing qualities. It is no longer imported into the United States.

J. H. Howard, C. E.

THE PHILADELPHIA ASPHALT TESTS.

To the Editor of Paving and Municipal Engineering.

Our attention has been drawn to several criticisms of our report on "Asphalt Paving in Philadelphia," a full abstract of which appeared in your last issue, and as our position in the matter is repeatedly misstated, we ask for space to correct our critics in a few respects.

The more elaborate discussion of the report is that of Mr. Clifford Richardson, of Washington, formerly Inspector of Asphalts and Cements for the District of Columbia, and at present, as we are informed, an official of the Barber Asphalt Co. Mr. Richardson says, to begin with:

> Tests for tensile strength of briquettes of Trinidad and Bermudez asphalt surface mixtures are very deceptive, because the asphaltic cement is but one factor in the physical properties of the briquette and of the result of the test, while the size of the sand, the amount of the impalpable dust in use, and the density of the briquettes are much larger, more important and more controlling elements.

In answer to this, we would say that the sand used in making the briquettes was absolutely of the same fineness, as carefully tested by us and in amount was 58 per cent. and 60 per cent. respectively. The amounts of impalpable dust in the Trinidad mixture and Bermudez No. 2 were 27 per cent. and 30 per cent. respectively, so that, allowing for the impalpable ash of the Trinidad, the two were almost identically composed, and the density of the two was as nearly equal as an experienced cement briquette maker could make it. As the tests were thrown open to the inspection and criticism of representatives of the two companies interested, as well as to the Director of Public Works, we took every precaution to make the conditions of manufacture and testing of the briquettes absolutely fair to all concerned.

It is entirely beside the subject for Mr. Richardson to say what we might or might not have found if we had tried glance pitch, coal tar, or land pitch. We were not asked to investigate anything but the refined Trinidad Lake Asphalt submitted by the Vulcanite Paving Co., and the refined Bermudez Asphalt submitted by the Pennsylvania Asphalt Paving Co. We might add that the oil residuums to be used were also simply and alone the two submitted by these companies respectively. Therefore, our conclusions, (3) and (4), were expressed in very guarded language and not made at all sweeping, as our critics seem to have hastily concluded. The language we used we think fully borne out by the figures of the tests. Further than that we have not expressed an opinion.

Mr. Richardson says again:

> It will be seen that the conclusion that the cementing materials which give the greatest strength in bituminous concretes must be the most valuable ones for paving purposes, based upon our methods of interpreting similar tests with hydraulic cement concrete, is entirely incorrect.

To this we would reply, first, that we announced no such theoretical conclusion; and, second, that in the sixth annual report of the Inspector of Asphalt and Cements for the District of Columbia, the writer (Mr. Clifford Richardson) says:

Upon the presence of this oil or soluble bitumen the viscosity and cementitious value of the pitch largely depend, but at the same time it is found that adding asphalt oil to pitch in which it is deficient does not restore or renew the properties which have been lost.

And

To the petroline the Trinidad pitch owes its cementitious value, and the larger the proportion the better the pitch, as has already been shown.

With regard to the question of the rotting of the paving composition in the gutters and when continuously wetted with water, we spoke of the "experience in Washington," not meaning thereby our observations in Washington, which are very limited, but that of the District officials (of whom Mr. Richardson was one) and quoted from them. We made, it is true, some laboratory experiments with paving compositions, but were careful to specify them as such. We have, however, made observations in the streets of Philadelphia, and the same can be made any day by visitors, which fully justify us in saying that asphalt paving compositions do disintegrate and rot in the gutters.

Mr. Richardson says, in conclusion, that he, "with many years' experience with asphalt and a two years' study of Bermudez material, would not be willing to draw such sweeping conclusions in regard to the two materials as the Philadelphia experts have done from the experience of a few weeks." We beg Mr. Richardson to read over our summary again and to state where these "sweeping conclusions" are found. Items (1) and (2) state analytical facts which Mr. Richardson has already agreed to in his printed reports; items (3) and (4) deal with specific mixtures which were tested. Mr. Richardson says in the last paragraph of his letter of criticism: "Under what conditions Trinidad or Bermudez asphalt pavements can be or are laid in Philadelphia, I am at present unacquainted;" had his experience been made on the same materials and under the same conditions, we feel certain we could have been more nearly in accord. Item (5) we have already spoken of; the language is hardly to be called sweeping. Nor does our final recommendation seem to be a sweeping one. We merely ask that, in view of our studies of these materials, the committee urge upon the municipal authorities the opening of sheet asphalt paving in Philadelphia to parties using Bermudez asphalt under the same guarantees as are exacted from those using Trinidad asphalt.

The other criticism is by Mr. H. C. Bowen, who combines with his position of "Tutor in Quantitative Analysis" in Columbia School of Mines the duties of chemist of the Barber Asphalt Company.

This gentleman indulges much more in innuendo than in legitimate criticism. We shall, therefore, be very brief in our reply to him.

He begins by saying "the report seems in part to have been piloted by interests other than independent and scientific investigation." We reply that the insinuation is absolutely untrue. The reasons why the Bermudez Company seems the chief beneficiary of the work are stated by the citizens' committee and by ourselves in the report.

Mr. Bowen says: "It is not a proper conclusion by these experts (in other matters than asphalt) that one asphalt is better than another, because soluble to a greater degree of bisulphide of carbon." What we said was: "The absence of much mineral matter makes it possible for the Bermudez asphalt to make more paving composition

than the Trinidad asphalt, taken ton for ton." It does not take an "asphalt expert," so-called, to decide that material containing only 1.50% ash and 97.22% bitumen is cheaper than another containing 34.51% of ash and 61.50% of bitumen.

Mr. Bowen concludes his criticism of the chemical work of the report by saying: "The chemical analysis and data given, beginning with 'specific gravity' and ending with 'flowing point,' seem to have been incorporated from those of the chemist of the Bermudez Company and not to have been made by any one of the experts of this report." Is this Mr. Bowen's idea of scientific criticism? While we have both taken part in scientific discussion and controversy at various times in past years, we do not recall any that started off in such a way and must respectfully decline beginning any such now. We would say that we have full analytical data for all our published results.

We will only note one point more of Mr. Bowen's remarks. He says: "Rotting of Trinidad pavement is scarcely known to-day." In this remarkable statement he is contradicted by all the authorities quoted in our report, and we can show him the contrary in a dozen localities in Philadelphia to-day.

Samuel P. Sadtler.
Henry Leffman.

Philadelphia, July 20, 1894.

MACHINERY AND TRADE.

The New York Hydraulic Pressed Brick Company will erect a plant at Canandaigua, N. Y.

The brick manufacturing plant of James H. McGregor, of Bloomington, Ill., will be enlarged.

The Warren-Scharf Asphalt Company has erected an asphalt mixing plant at Charleston, S. C.

A clay-working plant, for manufacturing sanitary piping, will be established at Bessimer, Ala., by G. W. Beggs & Co.

The Wauwatosa Brick Company has been incorporated at Milwaukee, Wis., with a capital stock of $40,000.

The stockholders of the Toledo Brick Company, at Toledo, O., made application June 27 for dissolution. An inventory of property, real and personal, amounts to $28,938.42. Capital stock, $15,000. Liabilities, $23,336.19.

The Diamond Brick and Tile Co., Kansas City, Mo., has certified to an increase of capital stock, from $60,000 to $100,000.

W. A. Connell, Scranton, Pa., is organizing a company to manufacture vitrified brick at $12 per thousand. The company has a capital stock of $55,000.

W. A. Eudaly, of Cincinnati, has a contract with the Huntingburg Brick and Tile Factory, at Huntingburg, Ind., for the erection of a down-draft kiln.

The Chicago brick manufacturers concluded, at a meeting held July 2, to advance the price of brick from $5 to $5.50, to take effect at once, while a further advance to $6 will go in force August 20. Further advances will be made, and it is thought that the prices will gradually reach those that existed during the World's Fair.

The Purington Paving Brick Company, of Galesburg, Ill., was compelled, during the recent railroad troubles, to close down its kilns because of its inability to get oil.

Articles of incorporation have been filed by the Henry Maurer & Sons Brick Manufacturing Company, whose offices and manufactories are located at Maurer, N. J.

The Assyrian Asphalt Company has been incorporated at Chicago, Ill., with a capital stock of $250,000. Incorporators, James P. Malette, Charles E. Eggleston and George F. Culmer.

Brick manufacturers in Des Moines, Ia., claim that the present season is the best that they have had for years, the demand for brick from outside sources being in excess of the supply. The capacity of all the yards is tested to their limit to keep pace with the rapidly increasing demand.

Oliphant, Pope & Co., organized a short time ago to manufacture vitrified brick, have awarded the contract for building a factory and office at New York and Plum streets, Syracuse, N. Y.

The Chicago Brick Makers Association has been incorporated at Chicago, by William H. Alsip, Adam J. Weckler, Dillwyn V. Purington, Adolph M. Haymann and Henry C. Hoyl.

The works of E. M. Freese & Co., Galion, O., have run continuously during the past few months of quiet business. During the present season they have averaged from ten to thirteen hours a day.

The Eagle Lake Brick and Tile Works have been incorporated at Eagle Lake, Will county, Ill. Capital stock, $8,000. Incorporators, Fred Erickson, William Wilkening, August Wehrman, Arthur Struve, Fred Brands and John Wilkening.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

The paving of West Main street, at Urbana, Ill., will begin about September 1.

Jefferson street will, when completed, be one of the handsomest paved streets in Bloomington, Ill.

The brick pavement being constructed in North street, at Middletown, N. Y., is progressing rapidly.

The law requiring wide tires on wagons will be enforced at Poughkeepsie, N. Y., after January 1, 1895.

The estimated cost for paving College avenue, Trenton, Mo., 7,900 square yards, is $6,975. This includes paving, macadamizing, sanding and curbing.

The Winona Construction Company, which has the contract for paving twenty-five blocks of streets at Quincy, Ill., is making rapid progress with the work.

The vitrified brick pavement on Quail street, for which bids are being asked at Albany, N. Y., will be that city's first experiment with brick as a paving material.

The board of public improvements at St. Louis, Mo., has reported favorably on vitrified brick pavements on those streets where the traffic is light, and the property-owners petition for it.

Judge Glenn, in the circuit court at Cambridge, Ill., refused to grant an injunction to the Rock Island and Burlington roads, restraining the city of Moline from beginning to pave the cross streets.

Henry Bessler, of Cedar Rapids, Ia., who has the contract for paving Main street in Peoria, Ill., is endeavoring to make it the model paved street in the State. The material used is Galesburg brick on a crushed stone foundation.

The property-owners on Fifty-eighth street, between Wentworth avenue and Halstead street, Chicago, have decided to adopt vitrified brick as a paving material for that thoroughfare. Galesburg brick will he used.

An opinion has been rendered by Judge Webb, at Atchison, Kan., favorable to the paving of North Fourth street. The question has been agitated for about three years, but each time was defeated by those who opposed it, by remonstrance petitions being filed.

Fred H. Pickles, city engineer at Winona, Minn., writes that improvement work in that city has been, so far, very light, except in the line of sidewalk construction, about six miles of which is being put in by the property-owners, under the city engineer's supervision.

The streets and alleys committee at Terre Haute, Ind., are trying washing the paved streets instead of sweeping them. The test will be given a two weeks' trial, and if it proves as satisfactory as it has so far, this method of street cleaning will probably be adopted.

At Newark, N. J., recently, the Barber Asphalt Paving Company cut into the pavement of Newton street to ascertain whether or not the asphalt was as thick as the specifications called for, when it was found that the thickness exceeded that called for in the specifications. The examination was witnessed by the board of works officials.

An offer made by Flood and Sherrill, at Glens Falls, N. Y., to pave the east side of Main street, between the electric railway track and the curb, for $1.68 per square, provided the village did the excavating and engineering, was accepted. The paving will be of Hornellsville brick, set on edge on a bed of sand, under which will be a layer of local brick placed sidewise.

An experiment will be made in the Main street pavement, at Jacksonville, Fla., by laying the brick directly on the sand, without stone or cement foundation After the proper grading is secured, the ground will be rolled with a heavy roller, then tamped and re-tamped, after which it is thought the foundation will be firm enough for the pavement. The crevices between the bricks will be filled with white sand.

CONTEMPLATED WORK.

Bartow, Fla., contemplates paving ten or fifteen miles of streets.

The paving of Third street is contemplated at East Liverpool, O.

The citizens of Ft. Scott, Kan., contemplate paving National avenue.

The estimated cost of the proposed paving at Charleston, Ill., is $26,450.

Second avenue, Lansingburgh, N. Y., will probably be paved with fire brick.

The citizens of Battle Creek, Mich., are contemplating repaving with brick.

A great number of streets have been recommended paved at Denver, Colo.

An effort will be made at Cincinnati, O., to pave Spring Grove avenue with marl.

A movement is being made at Bayonne, N. J., to pave Newark street, with asphalt.

An asphaltum pavement has been proposed for Poyntz avenue, at Manhattan, Kan.

An entirely new asphaltic pavement will be constructed on Park avenue, Utica, N. Y.

The question of paving Pittston avenue, at Avoca, Pa., has been indefinitely postponed.

A brick pavement has been recommended for Nicollett avenue, at Minneapolis, Minn.

Franklin street, from Ferry to Liberty street, Troy, N. Y., will be paved with vitrified brick.

West Second street, from Spring street to Chester, Little Rock, Ark., will be paved with vitrified brick.

The city council at Canton, O., has passed a resolution declaring it necessary to improve East Ninth street.

A petition has been presented to the council, at Leavenworth, Kan., asking that Delaware street be repaved.

The board of public works at Bridgeport, Ct., contemplate paving Main and State streets with sheet or block asphalt.

The property owners on Fourth street, Logansport, Ind., have decided upon a vitrified brick pavement for that street.

The estimated cost of the proposed paving of Stephenson, Walnut, Whistler and West streets, Freeport, Ill., is $36,758.28.

A revival of the plan to extend Flatbush avenue at Brooklyn, N. Y., is being urged. It is doubtful if it will be done very soon, however.

A petition has been presented the council, Leavenworth, Kan., to pave with vitrified brick, Delaware street, from Maine to Sixth.

A movement is being made at Michigan City, Ind., to improve and pave Wabash street, from Second to Boston, a distance of nine blocks.

Marks avenue, from Rogers avenue to Brooklyn avenue, Brooklyn, N. Y., will be repaved with asphalt. It is now paved with cobble-stones.

Two petitions for paving Corby street, at Omaha, Neb., one for sheet asphaltum and the other for vitrified brick, were referred to the committee on paving, curbing and guttering.

Meridian street, from South street to McCarty street, Indianapolis, Ind., will be paved with asphalt to a width of forty-five feet; length, 1,789 feet.

A resolution has been adopted at Saginaw, Mich., for paving Genesee avenue, from Tilden street to Jefferson avenue, with brick on concrete, this year.

The council committee at Detroit, Mich., has recommended $190,000 worth of forced paving, $175,000 worth of repaving and $80,000 worth of petitioned paving.

A petition has been made at Lancaster, Pa., for paving with asphalt or vitrified brick the square of East King street, between Lime and Shippen streets.

East Market street, Warren, O., will be paved in accordance with profiles and specifications on file at the city engineer's office. Albert E. Andrews, city clerk.

The property-owners on Franklin avenue, between Spruce and Vine streets, at Scranton, Pa., are divided on sheet asphalt and vitrified brick as a paving material for that thoroughfare.

The common council of Lansing, Mich., has ordered Washington avenue, south, paved with brick. This will be the first brick pavement constructed in the city. Estimated cost, $20,000.

Another petition has been made at Newark, N. J., for an asphaltic pavement through the entire length of Somerset street. An ordinance that had previously been passed called for trap rock.

A resolution has been passed at Houston, Tex., providing for paving the following streets: Crawford, from McKinney to Clay; Clay, from Crawford to Louisiana; Fannin, from Rusk to McGowen.

North Limestone street, at Lexington, Ky., will be paved with brick. A brick pavement will also be constructed on West Main street, without removing the macadam that is already on that street.

The property owners on D street, between Massachusetts avenue and Sixth street northeast, Washington, D. C., have petitioned that their street be placed upon the schedule for improvement and paved this year.

Several paving ordinances have been passed at Germantown, Pa. All are for vitrified brick pavements, and include the following streets: Cedar Lane, Berkley, Engle, Knorr, Ployd and Tacoma street, and Belfield and Stenton avenues.

The board of public works, at Indianapolis, Ind., has adopted resolutions providing for an asphaltic pavement on Georgia street, from Illinois street to Kentucky avenue, and for brick on Georgia street, from Illinois to Pennsylvania streets.

The property owners on Morrell avenue, from Newberry to Folsom place, and from Park to Folsom on Shepard avenue, Milwaukee, Wis., have petitioned the board of public works for a Trinidad asphalt pavement. This will include about 2,800 feet of paving.

Cement sidewalks have been ordered at Indianapolis as follows: Massachusetts avenue, from Ohio street to New York street, twenty feet wide and 808 feet long; Massachusetts avenue, from New York street to St. Clair street, fifteen feet wide and 5,531 feet long.

The city clerk, at Albany, N. Y., has been directed to advertise for proposals for paving Quail street, from Myrtle avenue to Madison avenue, with vitrified brick. It will require 2,460 yards of brick, 1,250 feet new curb, 172 feet circular curb, 355 feet new flagging.

Penn avenue, Scranton, Pa., is to be paved with asphalt this season. Ordinances pending for other streets, are Pine street with asphalt, excepting a block between Jefferson and Madison avenues where a stone block pavement will be laid on account of the steep incline; Franklin avenue, sheet asphalt; West Lackawanna street, stone blocks.

Paving ordinances were passed at Quincey, Ill., recently, which provide for paving with vitrified brick, Eighth street, from the north line of Broadway to the south line of Vine street; Jersey street, from Sixth to Fourth, and Fourth street, from Jersey to the Newcomb Hotel alley; Sixth street, from Jersey to State, and State street, from Sixth to Eighth.

The grading and paving committee at Brooklyn, N. Y., recently met and reported favorably on the proposed intentions to grade and pave the following: Bleecker street, cobble, $600; Huntington street, second-hand Belgian blocks, $2,100; Schenck street, granite, $17,000; West Ninth street, material not known, $6,700; McDonough street, asphalt, $9,000.

The committee on improvements, at Newport, Ky., contemplate using the remaining $16,000 street improvement bonds, as follows: Third street, between York and Monmouth streets, brick paving; Fifth street, from Licking to Saratoga and York streets, from Eight to Twelfth streets, with macadam, and as many more blocks in some other part of the city.

Two petitions have been circulated at Syracuse, N. Y., for the paving of Jefferson street. One for brick, from Franklin street around Armory park and through Jefferson street to its eastern terminus at Forman park, and the other for asphalt from Salina street to Forman park. A resolution has been passed, however, providing that when the street is paved it will be with asphalt.

The board of public works, Kansas City, Mo., has adopted resolutions to pave the following: Thirteenth street, from Main to Walnut, material to be selected by the property-owners; macadamize the Southwest boulevard, from Main street to Broadway, with a granite surface macadam, Lydia avenue, from Eighth street to Eighteenth street, and Campbell street, from Independence avenue to Fifth street, resolutions for which had been presented to pave with brick, were referred to the city engineer.

CONTRACTS TO BE LET.

R. E. Lloyd, city clerk at Danville, Ill., invites bids until August 9 for stone curbing in sundry streets.

Sealed proposals will be received until August 7, at Chicago, Ill., for improving sundry streets and alleys.

J. T. Browne, mayor, Houston, Tex., invites bids until August 13 for constructing sidewalks in sundry streets.

Sealed bids will be received by Henry Thacker, city clerk at Waukegan, Ill., until August 6, for grading County street and Ridgeland avenue.

Sealed proposals will be received at Omaha, Neb., until August 3 for repaving the intersection of Ninth and Jones streets with Sioux Falls granite. J. H. Winspear.

Sealed proposals will be received by the city secretary at Houston, Tex., until August 13, for the construction of brick, stone or cement sidewalks in a number of streets.

Sealed proposals will be received at the office of the board of administration, Cincinnati, O., until August 14, for the improvement of Chase avenue by paving with brick.

Sealed proposals will be received by the board of trustees, at Haughville, Marion county, Ind., until August 15, for graveling the roadway and sidewalks of Highland avenue.

Sealed proposals will be received at Toledo, O., until August 20, for paving Euclid avenue with Trinidad pitch lake asphalt, vitrified brick or Hallwood blocks. Lem P. Harris, city clerk.

Sealed proposals will be received by Bennett Carter, city clerk at Madisonville, O., until August 3, for the construction of cement sidewalks in Ward and Clason streets and Stewart avenue.

Sealed proposals will be received at the office of the board of administration, at Cincinnati, O., until August 14, for the improvement of Findlay street, from Western avenue to the west line of Dalton avenue, by grading, setting curbs, paving the roadway with brick and constructing the necessary culverts, drains and retaining walls.

Sealed proposals will be received at the office of the board of administration, Cincinnati, O., until August 14, for the improvement of Erkenbrecher avenue by macadamizing the roadway.

L. Griffith, Fort Wayne, Ind., will receive sealed proposals until August 3 for paving with vitrified brick, on a foundation of broken stone six inches deep after rolling, the alley between Berry and Wayne streets.

C. N. Mikels, town clerk at Newcastle, Ind., invites bids until August 7 for graveling the roadway of certain streets and the construction of sidewalks on both sides of said streets with hard-burned paving brick.

Sealed proposals will be received at the office of C. A. Herbig, Dayton, O., until August 8, for grading and graveling sidewalks, setting curbs, paving gutters and grading and graveling the roadway of sundry streets.

Sealed proposals will be received at Wapakoneta, O., until August 24, for grading and graveling River Road pike. Proposals must be made on blank forms, which will be furnished on application to Samuel Craig, engineer.

Sealed proposals will be received by the board of public works, Galveston, Tex., until August 2, for paving certain streets with creosoted long leaf, all heart yellow pine blocks. Will require 65,000 yards, more or less. E. K. Marrast, city clerk.

Sealed proposals will be received at Madisonville, O., until August 18, for grading, mecadamizing the road and laying crossings, setting curb and gutter stones and constructing the necessary drains and catch-basins on Ward street. Bennett Carter, clerk.

A. W. Miller, city clerk at Sandusky, O., will receive sealed proposals until August 14 for paving Columbus avenue from Water street to where the tracks of the Lake Shore and Michigan Southern R. R. Co. cross Columbus avenue, with brick according to plans and specifications on file in the office of the city civil engineer.

L. Hall, village clerk at Carthage, O., will receive sealed proposals until August 3 for the construction of an artificial stone sidewalk on the east side of McGregor avenue, from Oak street to the south corporation line. Plans and specifications on file in the office of the clerk and also in the office of E. F. Layman, C. E., 64 West Third street, Cincinnati, O.

Sealed proposals will be received at the office of the board of Hamilton county commissioners, at Cincinnati, O., until August 4, for the improvement of Tweed avenue, Cincinnati township, according to the plans and specifications on file in the office of the board of Hamilton county commissioners. Fred Bader, president.

Sealed proposals will be received by the board of administration, at Cincinnati, O., until August 13, for the improvement of Stettson street, from Imogene avenue to Bellevue avenue, by grading, setting curbs and crossings, flagging gutters, bowldering the roadway and constructing the necessary culverts, drains and retaining walls.

Sealed proposals will be received by the city council of Kenton, O., until August 4, for the construction of the following streets: Main street, from the north line of Carroll street to the south line of Marie avenue; Broadway street, from Columbus to Franklin street. Plans and specifications on file at the office of the city civil engineer.

Sealed proposals will be received at the office of the board of administration, at Cincinnati, O., until August 7, for paving with brick the roadway of Elder street, from Vine street to Race street, constructing necessary foundations, making excavation for same, furnishing and setting new curbs, redressing and rejointing and resetting old curbs.

Sealed proposals will be received at the office of the board of administration, at Cincinnati, O., until August 13, for the improvement of Elland street, from Burnet avenue to the north corporation line, by grading, setting curbs and crossings, flagging and paving gutters, macadamizing the roadway and constructing the necessary culverts, drains and retaining walls.

Sealed proposals will be received by C. E. Lynch, city clerk at Lima, O., until August 9, for paving the public square with vitrified brick, together with curbing, drainage, etc. Approximate quantities of work: 12,635 square yards of brick pavement; 1,400 lineal feet of six-inch curbing; 8 circular curb corners; 12 iron gutter crossings, and necessary sub-drainage, etc.

Sealed proposals will be received at the office of the board of administration, at Cincinnati, O., until August 7, for the improvement of Eighth street, from East line of Evans street to west line of Glenway avenue, by constructing the necessary foundations and making excavations for same, furnishing and paving the roadway with granite blocks, furnishing and setting new granite curbs, redressing, rejointing and resetting old curbs and furnishing and laying granite crossings.

Sealed proposals will be received by the city secretary at Houston, Tex., until August 6, for grading, paving and constructing the curb walls and gutters on Main street, from Preston to McKinney avenue; on Travis street, from Congress to Capitol avenue; on Louisiana street, from Congress to Texas avenue; on Preston avenue, from Main to Milam street; on Prairie avenue, from Milam to Smith street; on

Capitol avenue, from Maine to Louisiana street; on Franklin avenue, from Maine to San Jacinto street; on Congres avenue, from Maine to San Jacinto street; on San Jacinto street, from Franklin avenue to San Jacinto street bridge. J. T. Browne, Mayor.

CONTRACTS AWARDED.

William Marsden was awarded the contract for paving Main street, Jacksonville, Fla.

The contract for paving Buffalo street, at Lockport, N. Y., was awarded to C. N. Stainthorpe & Co. United States brick will be used.

The contract for paving Buffalo street with vitrified brick on concrete foundation, at Dunkirk, N. Y., was awarded to Jacob Rider for $34,347.

The contract for paving North Sixth street, at Terre Haute, Ind., was awarded to Voorhees & Grimes. Veedersburg block clay will be used.

Smith, Porter & Co., of New Cumberland, W. Va., secured the contract for a large quantity of brick for street paving purposes at Ludlow, Ky.

The contract for repaving a number of streets in Gloversville, N. Y., was awarded to the Park Paving Company, of Rochester, Pa., at $2.10 per square yard.

The city council of Portage, Wis., has awarded to A. J. Emerton the contract to furnish the city with 2,500 yards or more of granite chips, at $1.55 per yard.

J. U. Fritchey, Lancaster, Pa., was awarded the contract at York, Pa., for grading and paving four blocks with asphalt block, at $2.87 per square yard.

The contract for the improvement of Paddock road, at Bond Hill, O., was awarded to Jacob Glos, for $5,170. The material will be macadam, top-dressed with crushed bowlders.

The contract for paving the lower end of the Public Square and part of State street, at Watertown, N. Y., was awarded to the Warren-Scharf Asphalt Paving Company for $20,000.

Woodcock & Kneal, of Lansing, Mich., presented the lowest bid for paving Capitol avenue, in that city, from Ottawa street to Shiawassee street, with Hayden block on concrete foundation. The cost will be $8,584.75.

Contracts for paving were recently awarded at Syracuse, N. Y., as follows: Montgomery street, between East Genesee and Jefferson streets, Warren-Scharf Asphalt Paving Company, $12,880; Slocum avenue, between West Onondaga and Shorehard streets, Syracuse Improvement Company.

The cheapest contract for brick paving that has ever been let by the board of administration, at Cincinnati, was awarded to J. E. O'Brien July 23. The contract is to pave Winslow avenue with brick at an assessment of less than $2 per foot front.

The board of public works at Louisville, Ky., awarded the contract for reconstructing part of Broadway with vitrified brick to Phil Donahue, and the part of the work where the carriage-way is to be constructed of asphalt to the Barber Asphalt Company.

The contract for paving West Washington street, from the White river bridge to Bloomington street, Indianapolis, Ind., was awarded to Fulmer & Seibert, at $4.69 a foot. Zanesville block brick will be used, with stratified curb, and Murphy's patent grout filling.

Paving contracts were awarded at Erie, Pa., recently, as follows: State street, from Twelfth to Fourteenth street, Metropolitan brick on concrete base, V. D. Eichenlaub, $1.35; Eleventh street, between Cherry and Liberty streets, sheet asphalt, Henry Mayer, $2.80 per square yard.

H. A. Collar, city engineer at Grand Rapids, Mich., writes that during June paving contracts were awarded as follows: Cedar blocks on concrete, Cherry street and Lake avenue, from South East street to Kellogg avenue, $10,400.12; brick on concrete, South Ionia street, from Oakes street to Wealthy avenue, $15,000.

The Western Paving and Supply Company secured the contracts for asphalt paving at Milwaukee, Wis., as follows: Grand avenue, $2.33 per square yard; Prospect avenue, $2.09 per square yard; Summit avenue, $2.09 per square yard. The bid of the Bermudez company was the same as the Western Paving and Supply Company on the Grand avenue work, but the successful company's bid on curbing was lower.

SEWERS.

The construction of the sewer system at St. Johns, Mich., is progressing rapidly. The work is under the direction of Jens Hartwig, C. E., of St. Johns.

A special election held at Massillon, O., July 9, to vote on the proposition to issue $20,000 in city bonds for sewerage purposes and to give employment to the unemployed, was defeated.

The sewer which is about completed, at Philadelphia, Pa., is on an average of more than 28 feet below the surface for a distance of about 300 feet. The sewer varies in size from four to six feet and three inches in circumference. McMahon, Bennis & Co., of Germantown, Pa., are doing the work under the direction of Owen Coyle, an experienced mining engineer.

CONTEMPLATED WORK.

A trunk sewer is contemplated at Austin, Ill.

A system of sewerage has been proposed for Dansville, N. Y.

The Shone sewer system is recommended for Fairhaven, Mass.

A sewage disposal system is contemplated at Mansfield, O.

Plans have been prepared for a sewerage system for Scottdale, Pa.

A sewer is proposed for Fountain avenue and Cross street, at Middletown, Conn.

The estimated cost of the proposed sewerage system for Avon, N. Y., is $11,000.

An eighteen-inch sewer will probably be constructed in Main street, Medina, N. Y.

The construction of sewers is contemplated in a number of streets, at Troy, N. Y.

Plans have been submitted to the sewer commissioners of Avon, N. Y., for a sewerage system.

The citizens of Washington, Iowa, are considering the best methods for an outlet for the city's sewage.

A sewer will be constructed in Gordon avenue, between Detroit street and Franklin avenue, at Cleveland, O.

A resolution has been passed by the city council at LeMars, Iowa, providing for about five miles of sewerage.

The common council of Battle Creek, Mich., has voted to bond the city for $10,000 for the construction of sewers.

The common council, at Plainfield, N. J., has passed an ordinance providing for the construction of a system of sewerage.

The city council at Bloomington, Ill., has passed an ordinance providing for the extension of the West street brick sewer.

The board of public works at Denver, Colo., is contemplating the construction of storm sewers in the North Capitol Hill sewer district.

Better sewerage is needed at York, Pa., where the faults of the present sewerage system are said to be very noticeable at this time of the year.

A sewerage system is declared necessary for Delavan, Wis. Donsman and Sheldon, of Milwaukee, have been engaged to furnish plans and specifications.

The committee on sewers at Pawtucket, R. I., have recommended to the city council that sewers be constructed in Warren, Sayles and Appleton avenues, Belmont, Montgomery, Daniels, Myrtle and Sanford streets, and a "top sewer" in Newell and that portion of Warren avenue known as Cunliffe avenue.

The city council, at Ft. Dodge, Ia., has been petitioned by the property owners on Ninth street for a sanitary sewer. Resolutions for same will be passed.

The plans for the proposed sewer in Doan street have been examined by the officials of the city of Cleveland and Glenville, O. They are pronounced satisfactory.

CONTRACTS TO BE LET.

Address C. B. Dickinson regarding plans for a sewerage system at Ripon, Wis.

The city of Texarkana, Texas, is prepared to give valuable franchise for a sewerage system. Address, Mayor P. A. Turner.

Proposals will be received by S. J. Wilkerson, city clerk at Springfield, O., until August 6, for the construction of a pipe sewer.

Sealed proposals will be received at Muncie, Ind., until August 13, for constructing Main street sewer, No. 2. F. A. Elrod, city clerk.

Sealed proposals will be received at Toledo, Ohio, until August 6, for constructing sewers in sundry streets. I. P. Harris, city clerk.

Sealed proposals will be received at Chicago, Ill., until August 7, for laying private drains in Clark street, from Addison street to Racine avenue.

Sealed proposals will be received at Fremont, Ohio, until August 20, for the construction of sewers in quite a number of streets. Fred Hedrick.

A. W. Miller, city clerk at Sandusky, O., will receive sealed proposals until August 11 for the construction of a sewer in Madison street, sewer district No. 19.

Sealed proposals will be received by A. W. Miller, city clerk at Sandusky, O., until August 11, for the construction of a sewer in Meigs street, sewer district No. 18.

Sealed proposals will be received by Sumner T. Bisbee, clerk of council at Keokuk, Ia., until August 6, for constructing an eight-inch tile sewer through alleys in blocks 67 and 91.

W. Ellwood Wynne, corporation clerk of Avondale, Ohio, will receive sealed proposals until August 17, for the construction of sewers in Monroe street, Locust avenue and through private property.

Sealed proposals addressed to the Board of Trustees of the Sanitary District of Chicago will be received until August 22 for the excavation of that portion of the main drainage channel known as contract section fifteen, extending from station 1,480 to station 1,520, and consists in all of about 639,000 cubic yards of rock, 35,300 cubic yards of earth, and the building of 40,000 cubic yards of retaining walls.

CONTRACTS AWARDED.

Peter Simons, Quincy, Ill., was awarded the contract for six blocks of sewers, at Burlington, Ia.

The contract for the construction of sewers at Faribault, Minn., was awarded to O'Neil and Smith, a local firm, for $7,266.

The contract for constructing three miles of sewers at Muscatine, Iowa., was awarded to the Rockford Construction Company.

The contract for constructing sewers in Portsmouth, Va., was awarded to D. Lee Wardroper and Company, Gainesville, Ga., for $46,150.98.

The contract for the construction of a sewerage system in sub-district No. 4, at Muscatine, Ia., was awarded to the Dubuque Construction Company, of Dubuque, Ia.

Fred H. Pickles, city engineer at Winona, Minn., writes that the city council awarded the contract for a storm water sewer to Miller and Dolan, of that city, for $2,502.70.

The contract for constructing lateral sewers on Hamilton and Douglas Roads and Lincoln street, Bloomfield, N. J., was awarded to Henry M. Dowd & Co., of Orange, for $3,565.

The contract for constructing the extension of the Greene avenue relief sewer, from Marcy avenue to Lewis avenue, Brooklyn, N. Y., was awarded to James J. Moran and Company, for $169,512.70.

B. R. Morton, city engineer at Newport, Ky., writes that June 30 contracts were awarded for sewers and appurtenances as follows: William White, Newport, $13,660; W. J. and I. E. Irwin, Greenville, O., $5,275.

H. A. Collar, Grand Rapids, Mich., writes that during June contracts were awarded for sewers as follows: Packard and Baldwin streets, $728.42; Cass avenue, from Hall street to Highland avenue, $488.70; Warren avenue, from Cherry street to Buckeye street, $267.50.

The board of public works at New Haven, Conn., awarded sewer contracts as follows: Ellsworth avenue, C. W. Blakeslee & Sons, $662; Dickerman street, Anthony Carroll, $1,428; Davenport avenue, Patrick Maher & Son, $2,276; Cedar street, Lawrence O'Brien, $455; Orchard street, C. W. Blakeslee & Son, $1,554.30.

H. Ward, Binghamton, N. Y., writes that July 16 the council awarded sewer contracts as follows: Whitney and Fayette streets, 1,140 feet, 8 to 10-inch pipe, W. A. Conklin, $993; Seminary avenue, 280 feet, 8-inch sewer, J. C. Smith, $150; Clinton and Mygatt streets, 3,000 feet, brick sewer, J. C. Smith, $7,998; Collier street, 8 and 10-inch sewers, J. C. Smith, $639.

Sewer contracts were recently awarded at Pittsburgh, Pa., as follows: Rush street, P. J. Flinn, $749; main sewer on California avenue, A. Neillie and Company, $7,341.50; Chartiers street, E. F. Hughes, $580; Filbert street, Sloan and McIlvain and Ott Brothers, $958.75; main sewer on Hechelman street, Sloan and McIlvain and Ott Brothers, $5,290; Lowry street, Sloan and McIlvain and Ott Brothers, $2,437.60; Eggers street, A. Neillie and Company, $782.75; Lautner street, A. Neillie and Company, $614.16.

BRIDGES.

Saratoga, Minn., will have an iron bridge.

A bridge has been favorably voted on at Willow, Ill.

A bridge across Crooked Creek at Ripley, Ill., is contemplated.

Plans for the new city bridges at Scranton, Pa., have been prepared.

An iron bridge will be built over the Iowa river at River Junction, Ia.

The pontoon bridge between Covington and Sioux City, Ia., will be rebuilt.

A bridge at Benton street, Aurora, Ill., has been provided for in an ordinance.

A new bridge will soon be built across the Arkansas river, south of Mulvane, Kan.

J. W. Niehaus, Leavenworth, Kan., invites bids until August 6, for building two bridges.

A steel bridge will be built over Whitman's creek, at Apps Mills, Brantford, Ontario.

Several bridges will be built in the vicinity of Joliet, Ill., soon. Write to O. R. Rauchfuss.

Babylon, L. I., has voted to issue own bonds for $4,500 to build a steel bridge over Carll's river.

A new bridge will be built across Tiger Creek, five miles southeast of Bethel, Ill., this summer.

C. E. Bailey, Unionville, Mo., will receive bids until August 6, for erecting several bridges.

J. Pinks, Clarion, Pa., invites bids until August 3 for erecting an iron bridge across the Clarion river.

T. B. Larne, Franklin, Pa., invites bids until August 10, for building the iron superstructure of a bridge.

A new bridge will soon be built over the Kalamazoo river, in Pineplains township, Allegan county, Mich.

The work of construction on the new iron bridge over the Nemadji river at Superior, Wis., has begun.

The contract for a bridge over the Soo tracks at Minneapolis, Minn., was awarded to Rinker & Hoff, for $1,595.

It is thought that the bill for a new bridge across the Mississippi river, at St. Louis, Mo., will pass at this session.

The citizens near the east end of Mynster street, at Council Bluffs, Ia., have again petitioned for a bridge at that point.

A bill has been passed by the Senate authorizing the construction of a bridge over the Missouri river at Lexington, Mo.

The contract for a bridge across Coon river, at Valley Junction, Ia., was awarded to the Toledo Bridge Company for $9,000.

The city of Sioux City, Ia., has voted a tax of $346,000 in aid of the proposed combination bridge across the Missouri river.

The contract for the two bridges on Central and Spring streets, Chippewa, Wis., was awarded to R. A. Lange, Eau Claire, Wis.

The bill to authorize the construction of a bridge at Eagle Point, Wis., has been passed with amendments proposed by the secretary of war.

A petition has been in circulation at Vicksburg, Miss., for the erection of a steel bridge over Glass Bayou, at the foot of Washington street.

The aldermen of Marinette and Menominee, Wis., have recommended the construction of an iron bridge this fall between the two counties.

Surveys have been made at Exchange street, Rochester, N. Y., preparatory to a new bridge of modern design being built some time in the future.

The Franklin county commissioners are contemplating the construction of a new bridge over the canal near Shadeville, O. The estimated cost is $2,000.

The Charles river bridge, at Boston, Mass., has been declared unsafe and closed to travel. No immediate action will be taken to provide a substitute bridge.

Plans are being considered by the county commissioners of Shelby and Jefferson counties for a new bridge over the Cahaba river at Bainsford, near Birmingham, Ala.

The Indiana Bridge Company, Muncie, Ind., was awarded the contract for replacing the Lemon bridge, near Westville, Ind., with an iron structure. It will cost $9,000.

Contracts for the construction of the steel bridges were awarded at Vicksburg, Miss., as follows: Hankinson's ferry bridge, to the Youngstown Bridge Company, $14,300; Virginia bridge, at Redwood, Massilon Bridge Company, $2,892; Clear creek bridge, seven miles south of Bovina, Groton Bridge Company, $2,680.

The contract for a wooden bridge over Little Pigeon creek, two miles north of Gentryville, Ind., will be let August 4. Warrick and Spencer county commissioners.

The Baltimore and Sparrow's Point Electric Railroad, Baltimore, Md., has asked permission of the board of public works to build bridges over Colgate and Bear creeks.

The contract for a bridge over Hill Run branch, in Pleasant township, near Columbus, Ohio, was awarded to the Wrought Iron Bridge Company, Canton, O., for $735.50.

The Warren county commissioners, Warren, Pa., are considering the construction of new bridges over Jackson Run, on the North Warren road, and over Glade Run, in Glade township.

Viewers have been appointed at Chambersburg, Pa., to inspect the site of a proposed county bridge over the East branch of the Antietam, at Good's Fording, in Washington township.

The contract for the construction of the high wagon bridge across the Mississippi at Hastings, Minn., was awarded to the Wisconsin Bridge and Iron Company, at Milwaukee, for $39,050.

FOR SALE.

Sealed proposals will be received at the Treasurer's Office of Western Branch, N. H. D. V. S., until 12 o'clock noon, Wednesday, August 15, 1894, for purchase from the Home the following property: 1 25-horse power, fire-box, Steam Boiler, with 20-foot Stack; 1 Blake Stone Crusher, size of bed, 21x60 inches; 1 Stone Screen, 3 ft. diameter by 10 feet, ½, 1 and 2⅛ inch perforations. Used only one month.

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Address MAJ. W. B. SHOCKLEY, Treasurer, Nat. Mil. Home, Leavenworth County, Kan. Approved: COL. A. J. SMITH, Governor.

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—VIA—

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Knights of Pythias

Washington, D. C., in August.

G. A. R. at Pittsburgh,

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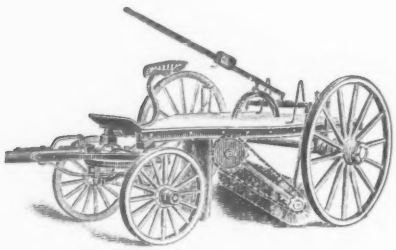

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All-steel sprinkler on four-spring platform Truck with best grade of Sarven wheels. Driver can shut off one side or both and regulate discharge of water.

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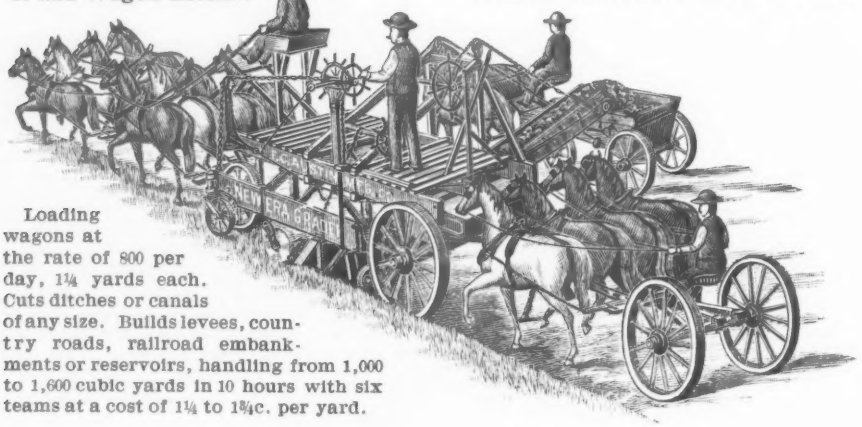

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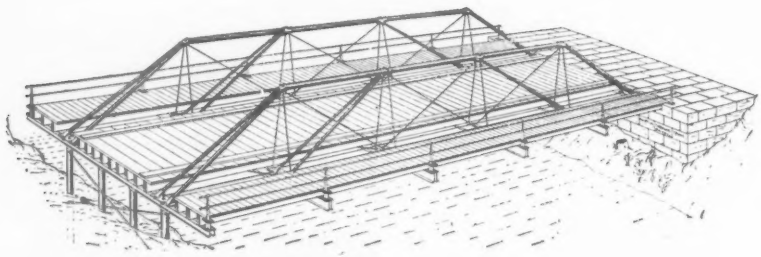

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